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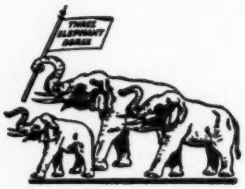

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Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

VOLUME XXX NO. 8

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WHERE RED EARS DON'T COUNT

Better Crops with PLANT FOOD

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VOL. XXX WASHINGTON, D. C., OCTOBER 1946 No. 8

For Better Crops . . . . .

Let Us Boost the Bee

Jeff McDermid

HERDSMEN for the honeybee have seldom if ever received the credit they deserve in the complex process of making eggs, milk, meat, and wool out of feed crops and forages—and none too much thanks for the well-filled apple barrel either.

"How doth the busy honeybee improve each shining hour"—and similar platitudes of ancient vintage come back to us as we scan our own shortcomings respecting the gratitude we owe the bees and our short-sightedness respecting the real importance of a few colonies of them in any good farming community.

In my youth the local "honeyman" was usually a shy, modest, soft-spoken, retiring guy who peddled comb or extracted honey from door to door and then went back to his smoke-pot and supers unsung by the townsfolk. Just one of the profession in my own hamlet was rather simple in the upper story, moreover, which did not count against his product. At any rate, none of these gentle honey purveyors got much praise for his skill and integrity. On the other hand, farmers who fetched in berries, melons, pork, or eggs to sell got a different reception. They were asked about the feeding and breeding of their hogs, the varieties of fruit, and the farm management systems involved.

One reason why the honeyman departed unquestioned was that most folks supposed that his bees lived off the largess of the surrounding country free gratis, and that only a queer sort of genius would get a kick out of a chance to be stung. Some blame for

this situation arose from a general lack of knowledge possessed by ordinary customers of the honeyman about the technical methods used and the great, mysterious, unsolved wonders inherent in the life cycle of the queen bee and her drones and workers. Folks raved in copybook style about the ant, and were told to "study her ways and be wise." But the honeyman plodded along in close kinship with nature and the marvels which belong to the bees.

Villagers could understand domestic mammals because they lived, ate, reproduced, and suckled much like themselves. But when it came to the insect world and particularly the "tame" division of it represented by the honeybee, so much of the lore was beyond belief or comprehension that it sounded too much like handling a flea circus—and they gave up and forgot it. In later decades we have fortunately secured for ourselves entomologists with commercial viewpoints and installed courses in beekeeping in colleges. Yet even with this progress toward achieving partnership with the bee most of us are a long way behind and still think the principal value of the honeybee is to manufacture honey—which it isn't. I thought so myself until just a few years ago. When more farmers and county agents and extensionists and their ilk grasp the fact that honey for batter cakes is absolutely not the most vital factor that makes bees so valuable, we will begin to restore the balance in the cycle from soil to sustenance.

BACK when nature was in the raw hereabouts, there was a far better balance established between the wild plant life and the wild insects which pollinated vegetation. For it is true that honeybees are by no means the only insects that favor flowers with their visitations, several species of flies and beetles being gifted with that habit. But the honeybee remains, after all, the steadiest customer of the floral system, inasmuch as substances obtained by them from the blossoms supply all the larder of the Queen's empire, young and old alike depending upon nectar and pollen for their existence.

It has happened in the course of events that the woodlands, marshes, and thickets have been opened up, drained, and hacked away, at least in most areas situated adjacent to the fields when men grew forage for their animals. This drive to settle up and civilize and reclaim the earth has been especially characteristic of America. We have done it all too well and all too dismally in some spots. Great blocks of uniform domestic plants replace the variety of native wild flowers and other herbage, and the nests as well as the ranges of the wild insects have been whittled away. I remember how common it used to be to find big hornets' nests in fence corners and wild bee trees around the farms—but now they are scarce indeed. This means that the domestic honeybee remains almost alone to do the job which in the past was performed by his wild prototypes and by countless wasps and other pollinators.

SCIENTIFIC beemen say that this is just too bad, because many of the wild insects were even more efficient than honeybees in this task. But right here we must stop and admit that absolutely nothing has been done about this, all normal effort being contrariwise. Is it time we set up some kind of method or name some specialists to encourage protective and propagating measures for certain helpful species of insects? Hitherto we have classed everything that belonged to the wild insect world as man's enemies and pests. Last week I saw some children kill a harmless but gawky praying mantis, because it looked so weird and fierce outwardly. We have spent millions in trying to kill harmful insects, sometimes in vain, but little has been done to save the cooperative insects. Most of us wouldn't recognize one from a "tumblebug" or a "vinegaroon" if we saw it.

And still another thing which impresses me is that we have not to my knowledge ever subsidized the honeyman. Not that I crave more subsidies to reduce my grocery bills, but it strikes me as queer that an industry which has been actually plugging hard for agriculture for half a century should take its reward on the chin. This doesn't mean that nightriders or inter-

lopers have injured the beeman or ripped out his apiaries, but that millions of gallons of stuff that is deadly to bees has been squirted around promiscuously in rural fruit-growing zones, so that many colonies have been retarded and their numbers reduced more or less by poison.

Of course, we have heard winter short-course folks address the farmers and remind them not to use arsenicals on trees during full bloom, but this hint has too often been forgotten or perhaps found impractical to thoroughly control. Anyhow, when combined with a modest if not a losing price for honey over the years, plus difficult winter feeding conditions for the colonies, no sugar being on tap during the war, we get some idea of the misery thoughtlessly perpetrated on the beeman. Maybe it's no wonder that the growers of legume seed crops find it hard to produce enough, even with a generous government bonus, to extend the area of high-protein, high-vitamin roughage so badly needed to keep up the country's economic output of health protective foods like milk. If this is really to become a land of milk and honey, some effort must be made to show the close relation between these two products, both in the growing and the eating value thereof.

According to facts found in a Federal survey, there are 22 fruit crops of prominence which depend on honeybees for pollination or else yield more freely when such is the case. Not to list them all, we pick out a few favorites without whose toothsome flavor our meals would often be sadly lacking—even when we are forced to pay 65 cents or more for a No. 2 can. Apples top the list, followed by apricots, cherries, cranberries, grapes, muskmelons, watermelons, peaches, nectarines, pears, plums, the lowly prune, raspberries, and strawberries. The bees must have done a major job last spring for the peach crop hit an all-time high of 83 million bushels with another record for pears at 34 million. Grapes and cranberries also have done a tremendous comeback, in which the bee must share the glory. Now if you carry this surplus bounty back to the food stores, and if OPA lets the much-abused law of supply and demand take effect, we will soon be able to thank the bees for a reduction in the money we must pay for those No. 2 cans aforesaid. But instead of the beeman and his Queen taking the bow, probably some publicized politician will pose for his picture as the responsible party for plenty peaches.

THERE are 30 or more seed crops that rely on the buzzing winged visitors. Alfalfa and asparagus, broccoli and buckwheat, cabbages, carrots, and clovers, King cotton himself, flax, onions, pumpkins, rape and radish, squash and rutabaga, sunflowers and sweetclover, turnips, trefoil, and the vetches are found among these dependents on the apiary.

If one were holding court to try a case relating to the bee and pollination it would be wiser to call as witnesses those folks who specialize in plants and plant breeding rather than to ask for endorsement from the professional

(*Turn to page* 49)

Soil Testing—A Practical Aid to the Grower and Industry

By Jackson B. Hester

Soil Technologist, Campbell Soup Company, Riverton, New Jersey

THE profound influence that the elements, absorbed by plants, have upon man and animals (5, 12) has received considerable attention in recent years. The major nutrient requirements for most crops have been well established (4, 8, 12). However, a review of the literature on the development of the use of various nutrients in crop production shows that one of the most extensive problems has been methods of determining soil nutrient requirements for efficient crop production. Almost every conceivable means of measuring the soil needs, so that general recommendations can be made, has been tried. The fact remains that the available mineral elements in a soil (4, 8, 12) vary tremendously within a given soil type and within a given community, depending to a great extent upon the previous treatment of the land. Available plant nutrients in the soil can be determined by ordinary chemical analyses rather accurately and furthermore, certain of these analyses are adapted to rapid procedures (1, 2, 3, 4, 6, 7, 9, 10, 11, 13).

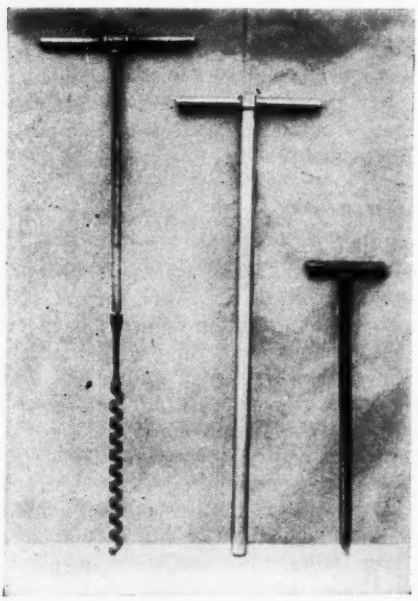

Fig. 1. Soil auger, soil tube, and trowel for soil sampling.

The requirement for production of efficient crop yields on the soil from the standpoint of available nutrients is not merely an analysis of the soil for the availability of certain nutrients. It is also an analysis to see if the environment of the soil is favorable to the crop grown. For example, a soil may have sufficient available potash to grow a number of crops, but if the soil is too acid for the crop concerned, the available potash is unused. From this standpoint a soil-testing system must be of the nature to give not only the available nutrients in the soil, but an indication of the environmental conditions present.

A grower is concerned about the limiting factors in crop production, i. e., the limiting factors over which he has some control. He is willing to take his chances with the weather. He also knows that the weather influences the availability of plant nutrients in the soil, particularly nitrogen. Therefore, he is anxious to know how to cope with the situation when there is a drastic

change in climatic conditions. The grower also knows that the plant nutrient requirements for the various soils and cropping practices on his farm vary. He knows that sometimes he has the right combination and produces a bumper crop and other times he produces poor crops. He would like to take as much of the guess out of his practices as possible. From that standpoint, he knows some method of analysis must be available if he is going to get the true answer.

The fact that there are certain nutrient deficiencies in most soils has been well established; and that these deficiencies can be found in most communities, but on various soils in that community, is likewise common knowledge. The conditions in the soil that are favorable for many economical crops have been established (4, 8, 12). The fact that certain laboratories for making soil analyses have proven satisfactory can not be questioned. This discussion will deal with the equipment and procedures for practical work in this field.

The Soil Sample

Suppose a workable system be briefly described from beginning to end. It is without question that the more information one has about the soil and cropping practices, the better equipped he is to make a practical recommendation.

It is obvious that the soil to be analyzed must be representative of the field in which the crop is to be grown. From practical experience it has been proven that an experienced man has better knowledge of how to take a soil sample than one that has little conception of what the chemist does with the soil after he receives it. Furthermore, it is necessary to have the proper tools with which to take a sample. The three most satisfactory tools are (1) a soil auger for deep, stony, and compact soils; (2) a soil-sampling tube for ordinary sampling; and (3) a trowel for sandy soils. (See figure 1.) These tools are satisfactory for drawing samples because uniform cores are drawn from the soil and all of the soil drawn can be brought to the laboratory where proper methods for screening and mixing are available.

Personnel

The person that draws the samples should be trained in the proper method of soil sampling. In most of the processing industries, drawing samples is only a part-time job, and thus he is available for other work during the year. He should be taught to recognize different soil types and how to avoid areas in the field that are not representative of the field as a whole. He should be taught fundamentals of drawing good soil samples and what

Name .....

Address .....

Field .....

Previous crop .....

Present condition .....

Topography: Level Rolling Sloping Steep

Drainage: Good Fair Poor Tiled

Lime ..... Manure .....

Form 829 300p 6x3 7-43

Fig. 2. Information obtained from grower at the time the soil sample is taken.

good samples mean to the complete picture. The representative must know what information to get from the grower and to what extent the information obtained is reliable. The information shown in figure 2 is about all that is necessary to be obtained under most conditions.

The soil sample should be taken at such a period as to give adequate time for the analyses and to get the information back into the hands of the grower so that he can have sufficient time to make his purchases and plan his cropping program. It has been found that the fall of the year is a satisfactory season. The weak points of the soil are likely to show up at this time since a crop, more than likely, has been removed from the soil. Therefore, during the early part of the fall of the year the representative calls upon the grower, obtains information about where he plans to plant his next year's cash crop, and draws the soil sample.

The most convenient container for the sample is the round pint oyster cup (Sealright). This cup will hold 10 to 15 borings of soil and is very convenient for drying and holding the screened sample, figure 3. The samples are brought to some convenient place near the laboratory for drying and screening. The 2-millimeter-round-hole screen is very satisfactory for screening soils. It is best to screen them at a state of dryness that permits easy crumbling of the soil. Rubbing the soil through the screen with a rubber pestle is expedient.

Analyses

Once the samples have been air-dried, mixed, and screened, they are ready for chemical analysis. The usual analyses made are for pH value, available calcium, magnesium, ammonia and nitrate nitrogen, phosphorus, potash, manganese, total organic matter, and toxic aluminum. Special samples may require other analyses such as total salt concentration, sulfates, nitrite nitrogen, chlorides, and ferrous and ferric iron. Also special plant tests for boron (4) may be advantageous and, too, a mechanical analysis of the soil by the hydrometer method. See figures 4 and 5. At any rate, the color of the soil should be recorded and the sand, silt, and clay estimated.

The pH value is one of the tests that gives considerable information about the soil. It gives an insight as to the percentage base saturation in the soil and the possibility of toxic amounts of aluminum coming into solution. The glass electrode has become stand-

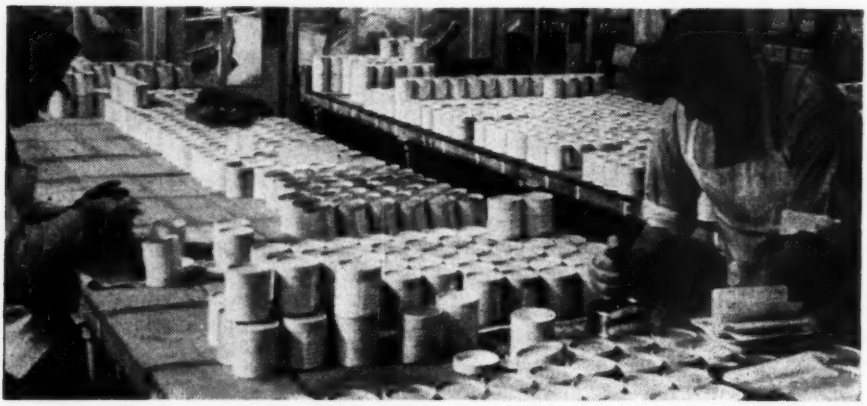

Fig. 3. Drying, mixing, and screening soil samples.

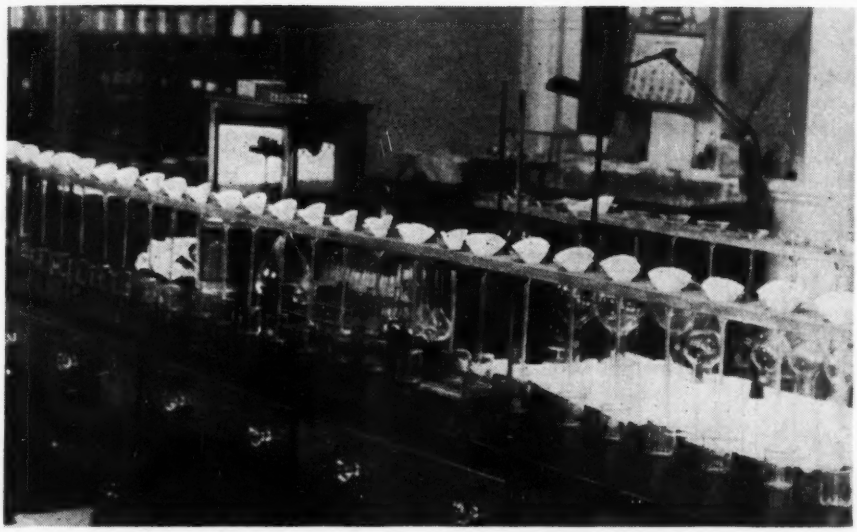

Fig. 4. Equipment used in well-developed laboratory for soil analyses.

ard equipment for this test, although good results can be obtained with the colorimetric procedure.

The soil may be extracted in an extraction flask and filtered for analysis. Most rapid procedures make all the tests for the elements on one extract.

The laboratory must be equipped with good methods of measuring turbidity and colors. A photelometer is a very fine piece of equipment for this purpose. Campbell Soup Company's laboratory handles some 6,000 to 8,000 samples each fall. This can only be done through careful planning and with considerable equipment.

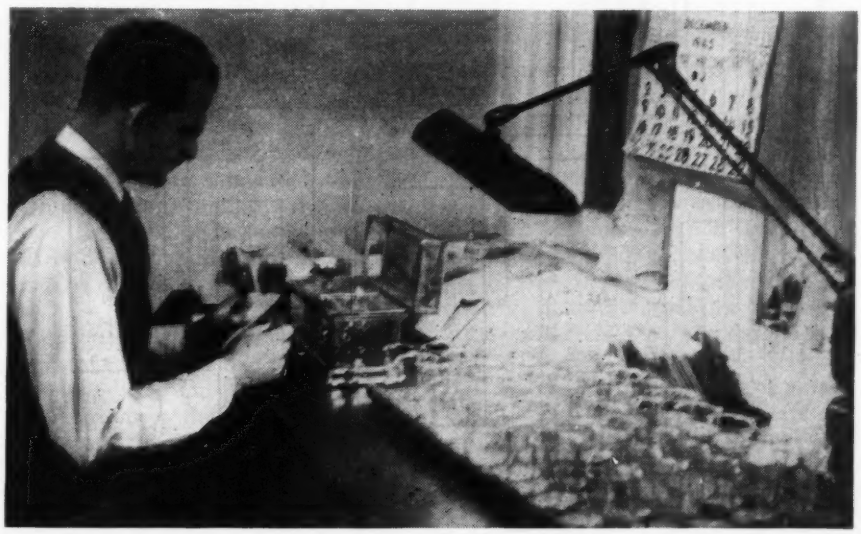

Fig. 5. Weighing samples for soil organic matter analysis.

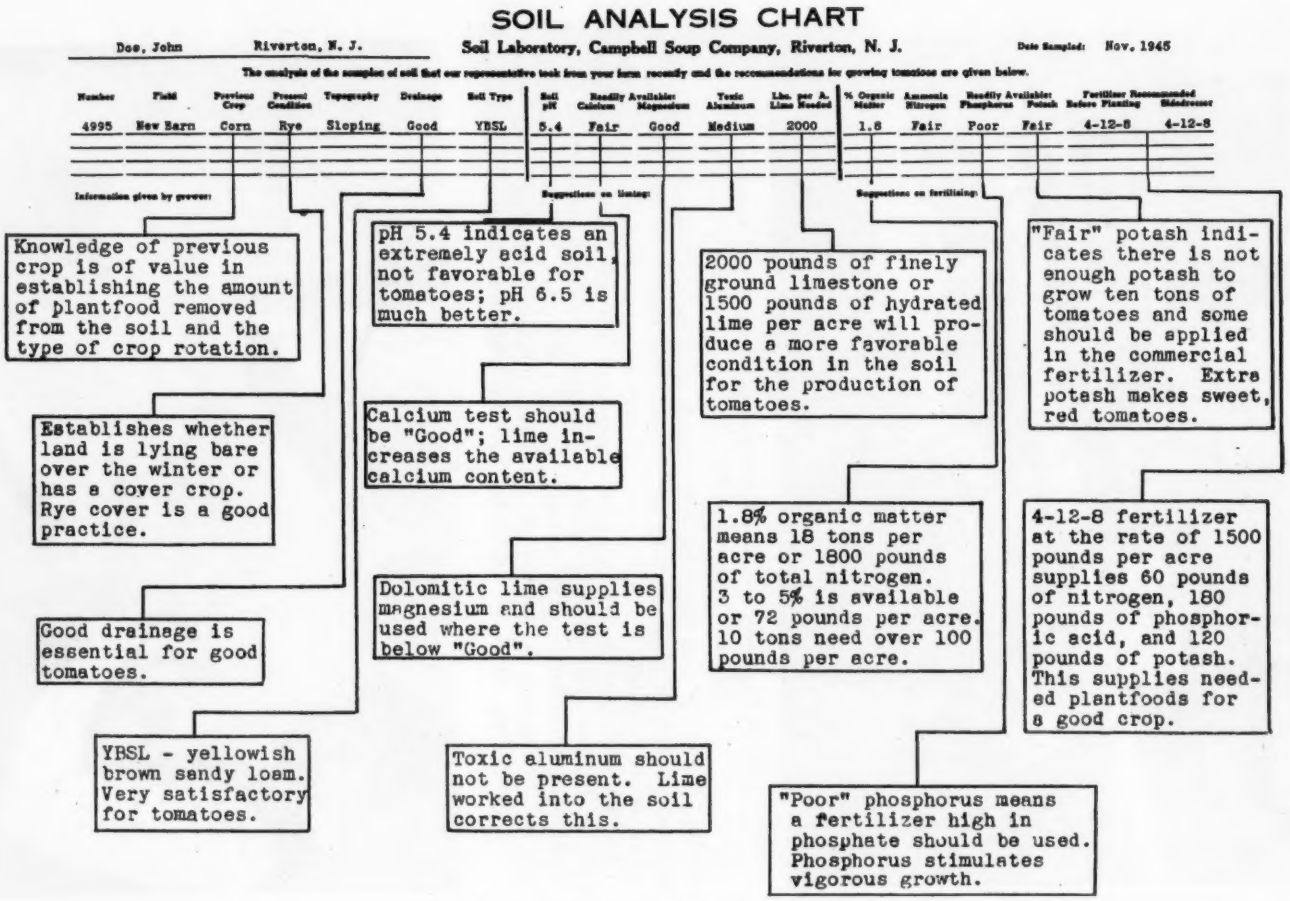
SOIL ANALYSIS CHART
Doe, John
Riverton, N. J.
Soil Laboratory, Campbell Soup Company, Riverton, N. J.
Date Sampled: Nov. 1945
The analysis of the samples of soil that our representative took from your farm recently and the recommendations for growing tomatoes are given below.
Number
Field
Previous Crop
Present Condition
Topography
Drainage
Soil Type
Soil pH
Readily Available: Calcium
Readily Available: Magnesium
Toxic Aluminum
Lbs. per A. Lime Needed
% Organic Matter
Ammonia Nitrogen
Readily Available: Phosphorus
Readily Available: Potash
Fertilizer Recommended: Before Planting
Fertilizer Recommended: Sidedresser
4995
New Barn
Corn
Rye
Sloping
Good
YBSL
5.4
Fair
Good
Medium
2000
1.8
Fair
Poor
Fair
4-12-8
4-12-8
Information given by grower:
Suggestions on liming:
Suggestions on fertilizing:
Knowledge of previous crop is of value in establishing the amount of plantfood removed from the soil and the type of crop rotation.
Establishes whether land is lying bare over the winter or has a cover crop. Rye cover is a good practice.
Good drainage is essential for good tomatoes.
YBSL - yellowish brown sandy loam. Very satisfactory for tomatoes.
pH 5.4 indicates an extremely acid soil, not favorable for tomatoes; pH 6.5 is much better.
Calcium test should be "Good"; lime increases the available calcium content.
Dolomitic lime supplies magnesium and should be used where the test is below "Good".
Toxic aluminum should not be present. Lime worked into the soil corrects this.
2000 pounds of finely ground limestone or 1500 pounds of hydrated lime per acre will produce a more favorable condition in the soil for the production of tomatoes.
1.8% organic matter means 18 tons per acre or 1800 pounds of total nitrogen. 3 to 5% is available or 72 pounds per acre. 10 tons need over 100 pounds per acre.
"Poor" phosphorus means a fertilizer high in phosphate should be used. Phosphorus stimulates vigorous growth.
"Fair" potash indicates there is not enough potash to grow ten tons of tomatoes and some should be applied in the commercial fertilizer. Extra potash makes sweet, red tomatoes.
4-12-8 fertilizer at the rate of 1500 pounds per acre supplies 60 pounds of nitrogen, 180 pounds of phosphoric acid, and 120 pounds of potash. This supplies needed plantfoods for a good crop.

Fig. 6. Recommendation to the grower for tomatoes.

Plant Analyses

This laboratory also handles 2,000 or more plant samples each summer. With the use of the Waring Blendor and the photelometer, analyses for the major plant nutrients in the plant can be completed in a few minutes. From the standpoint of diagnosis this is very important. An analysis of a plant for the nutrients being absorbed may lead to a side-dressing procedure that will increase the yield or it may save the grower money and time.

The Recommendation

Once the soil analysis has been made, it is important to get it into the hands of the grower in a form that is understandable. For the most part, growers are practical men and chemical symbols and names do not mean much to them. Therefore, it is desirable to report the results in such a way as to be both understandable and practical to them. The form of the report is important. The tests and recommendations must be logical and workable for the grower. The method of recommendation shown in figure 6 has proven very successful.

The recommendation must be workable and sound. It is impractical to recommend 2,150 pounds of a liming material because the spreading equipment is not accurate to that degree. It is practical to recommend one ton or one and one-half tons of a liming material or to recommend a dolomite or high calcium lime. It is also practical that this be recommended for fall or spring application, and that it be plowed down or disked into the soil.

Soil analyses or variations shown by them do not mean that there must be an outlandish number of grades of fertilizer to meet the needs demanded. A few well-diversified grades will cover most needs. Such analyses as 5-10-10, 4-12-8, 4-8-12, 3-12-15, 0-12-12, 10-0-20, 7-7-7, and the regular materials are usually sufficient for upland soils.

Research Work

Research work on new methods of testing and improvement in technique must continue. Greenhouse pot work, long chemical methods, and finally field experiments (4) must be conducted and correlations made with the short tests if maximum use is to be obtained from the results of the tests. The grower must know of the work done on the soil analyses and the background of the tests if he is to have thorough confidence in them. This is best done through personal contact and published literature.

Follow-Up Work

The soil tests and recommendations must be followed up to see whether the grower followed the recommendations and what yields he obtained. These records are kept from year to year and through that means a complete picture of his entire farm may soon be obtained. It is not uncommon when one attends meetings to find growers there with the soil tests from five to eight years back. They are eager to discuss the results of the analyses and point out how they check with some of the things they have done to the soil.

Soil Testing Pays

Soil testing pays because it calls the attention of the grower to the needs of his soil for specific crop production. For instance, in 1941 a survey of 108 tomato growers revealed that those growers producing more than 10 tons of tomatoes per acre had an average grade of 74% U. S. No. 1 and 25% U. S. No. 2 tomatoes, whereas those growers that produced less than five tons per acre had an average grade of 61% U. S. No. 1, 36% U. S. No. 2, and 3% culls. Consequently, it pays in quality. In 1944, a survey of 40 growers in one county in Pennsylvania revealed that for those having their soil tested, the average yield was 7.46 tons per acre, whereas those without soil

(*Turn to page* 41)

Plant Breeding in Relation to Soil Fertility and Climate[1]

By Fred H. Hull

Agricultural Experiment Station, University of Florida, Gainesville, Florida

THIS opportunity to discuss plant breeding in relation to soil fertility and climate with a group of soils specialists has been accepted gladly because I think the direction of plant breeding may sometimes depend on progress in soil science.

With continued advances in the science of soil fertility and fertilizer practice, and with the development of better soil-improvement crops such as the lupine, we may expect the level of fertility of crop lands in Florida to be raised appreciably. This may be particularly true of lands growing corn, peanuts, oats, and the grazing crops. Natural fertility is low and a minimum of fertilizer is used.

Poor Breeds Are Poor Feeders

Soil fertility is measured finally by crop production, I suppose, provided that a well-adapted variety of the crop is available. There is a widespread belief that peanuts often fail to make profitable responses to fertilizer. And it is reported that additional responses of corn in Florida to higher rates of fertilizer are sometimes disappointing. Explanations of these failures are not readily apparent nor simple. I am led first to consider that the peanut is not a thoroughly domesticated plant. It will persist for some time in sod land. The peanut is a poor land crop. We may have somewhat of a parallel case in the range cow or the range hog. These animals may survive and reproduce on the range better than improved pure breeds. But in the dairy barn or feed lot, performance of purebreds is far superior to that of range animals. The latter seem unable to respond fully to abundant nutrition.

We may, of course, question whether or not the turning of a heavy leguminous crop and balancing the nitrogen with potash and phosphate will always provide abundant nutrition in the full sense to a following crop. Other elements may be deficient or out of balance initially or may be made so by heavy rainfall. How serious this general problem is and how rapidly the soil chemist may solve it, I do not know. My interest is in the burden of unsolved residue which will presumably fall on the plant breeder. If this problem is of slight importance there is still the question of drouth which may be serious where a high fertility level is built up on light land and a thick planting of the crop is made. Relation of corn production to climatic factors must be quite different when fertilizer rate and thickness of planting are both doubled.

Most of the corn grown in Florida has been here a long time and has perhaps achieved some degree of adaptation to prevailing climate, soil, and soil management. If now we begin looking for a corn which will produce efficiently after lupines with heavy fertilization and thick planting, will we find it among the varieties and hybrids developed in the older practice? Or how fast may we go in developing the desired type? The question of how

[1] Presented before the Florida Society of Soil Science, February 1946.

well corn may respond to high rates of nitrogen, potassium, and phosphorus which is being currently investigated at various points in the South might be varied to ask at what levels of these and other elements might corn-breeding operations best be done? No one, of course, has any definite answers to these questions. I shall devote my remaining discussion to some of the factors which may bear on them.

Stringfield and Salter (6) tested several local corn varieties and some corn hybrids in Ohio on fertility levels ranging from no treatment to 16 tons of stable manure plus 800 pounds of fertilizer per acre. They found differential varietal response to fertility levels in two of five seasons. Differential response of varieties to seasons was highly significant and much greater than that to fertility levels. Some varieties were superior in the dry seasons—not so much so in wet seasons. Other varieties were definitely "good season" performers.

Smith (5) and Lyness (4) separately tested different strains of corn on different levels of phosphorus. Each one found marked differences among lines on low phosphorus. Smith found lesser differences on low nitrogen. Efficient lines on low phosphorus had greater proportions of secondary to primary roots. Harvey (1) found significant differences in responses of corn hybrids and inbred lines to ammonium and nitrate nitrogen in mineral solution cultures. Similar work has shown inherited differences in nutritional requirements among different pure strains of tomatoes, and of other crop plants. "Whitebud" of corn which has been corrected in Florida by application of zinc salts was much more severe in some varieties of corn than in others. The more susceptible varieties were those developed on the more fertile soils.

This brief review supports the general belief that crop plants may be bred for adaptations to variations in available nutrient elements and to variations in climatic factors. A vast amount of data from cooperative tests of experimental hybrids by state and federal agencies shows also a considerable amount of differential response of hybrids to conditions in different states at the same lattitude.

Let us look now at the general picture of corn-breeding experience for indications of how rapidly we may breed corn for adaptation and how far the process may be carried.

Domesticating Corn

Most of the work of developing the highly domesticated corn plant with its unique structure, the ear, was done in past centuries. Controlled breeding experiments were begun 50 years ago when Hopkins at the Illinois Experiment Station introduced his ear-row breeding plan. One novel feature was the planting of a row of corn with seed taken from a single ear. Ear-row selection was the selection of a few of the more productive of 100 such ear rows.

A few years after ear-row breeding began the still further complication of growing ear-rows from self-fertilized plants was started. This new practice eventually led to hybrid corn which now grows on about two-thirds of the corn acreage of the United States. The realized yield improvement from hybrid corn is estimated at about 20 per cent, although considerably higher gains have been obtained in experimental plots. Such gains are obtained with only a few certain combinations of inbred lines. Many combinations are actually less productive than the original varieties from which the inbred lines were derived.

Among some corn breeders there has been the expectation that a considerable further advance in yield of hybrids would appear when a new cycle of inbred lines had been derived from crosses of the best lines of the first cycle. It is now fairly clear that this expectation is not to be realized beyond a very limited extent which is

truly disappointing if no alternative can be found.

Various explanations have been suggested for the apparent halt in progress of developing still higher yielding hybrid corn. One is that a close approach to a physiological ceiling has been realized in the better hybrids now in hand. Another is that the later cycles of work have been too limited in extent.

A third possible explanation which has been of great interest to me recently is that our breeding operations have been designed on a misconception of the genetic nature of hybrid vigor in corn.

If we must accept either of the first two explanations, we must be prepared to be content with little more than 20 per cent improvement of corn yield in the South by the use of hybrid seed. The extensive work of the past 20 years on development of hybrid corn in the main corn belt area is not likely to be equalled anywhere in the South for a long time. If we may find the third explanation correct, our expectations for improvement of corn yield may be considerably greater.

Behavior of Cycles

Behavior of corn yield in breeding experiments has been somewhat enigmatic. First of all the extensive and long continued ear-row selection effected hardly any improvement of yield at all. In the two succeeding decades selection within and among self-fertilized lines based both on appearance of the lines and on hybrid performance effected an improvement of 20 per cent in yields. This not inconsiderable result was obtained early with the first cycle of inbred lines. Later work with second and even third cycles of inbred lines has provided little or no further improvement of yield. In contrast, second and third cycle lines are frequently very great improvements over lines of the first cycle in many other desirable characteristics. We recall, too, that the Illinois ear-row selection experiments were very effective in modifying oil and protein content of the seed and morphology of the plant.

In 1935, we began at the Florida Station with a cross of the large late field variety Tuxpan and the small early sweet variety, Golden Cross Bantam. Selection was practiced at approximately the rate of the best plant in 100 for the most leaves or nodes on the stalk. The astounding result after four generations was a new strain with an average of 20½ leaves or nodes above ground. The average for original stock was 13. No plant with 20 leaves was observed among some 1,300 of the original stock. But by measuring the variation statistically of several hundred of the original plants it was estimated that one with 20 nodes might have been expected once among some 10,000,000. Thus, the gain effected by growing about one-fourth acre of corn each year for four years was approximately that of growing 3,000 acres the first year and selecting the best single plant. The principle involved here is roughly analagous to dilution technic. A laboratory utensil is rinsed three times successively with 10 c.c. each time to obtain the same dilution of contamination with 30 c.c. as would be done by 1,000 c.c. in a single rinsing.

This multiplicative principle must have been understood, at least in part, by early operators of ear-row selection. Failure of the ear-row method and subsequent success of hybrid corn for improvement of so important a character as corn yield have probably caused undue emphasis to be given to inbreeding and too little to recurrent selection as plant-breeding tools.

Selection for high oil on the ear-row plan continued for 28 years by the Illinois Experiment Station achieved a result equivalent to improving yield 120 per cent. This comparison is made with due allowance for initial genetic variability of the respective characters.

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Soil Aeration Affects Fertilizer Needs

By Kirk Lawton[1]

Soil Science Department, Michigan State College, East Lansing, Michigan

IN the last few years there has been a growing interest in the subject of soil aeration. Although considerable investigation has been carried out by Cannon (2) and others concerning germination, growth, respiration, and other metabolic activities of plants as influenced by soil aeration, the role of oxygen and carbon dioxide in the absorption of nutrients from field soils by crops has only been partially explored. The need for more study of soil aeration as it affects plant growth has been pointed out in a recent article by Hoffer (5).

In culture solutions plant physiologists have studied rather closely the influence of aeration on nutrient uptake of a number of crop plants such as soybeans, tomatoes, and barley. Different plants have been found to have different aeration requirements. It is generally agreed that oxygen must be supplied to maintain cell activities associated with the accumulation of salts

[1]The author was formerly associated with the Department of Agronomy, Iowa State College. Now with Soil Science Department, Michigan State College.

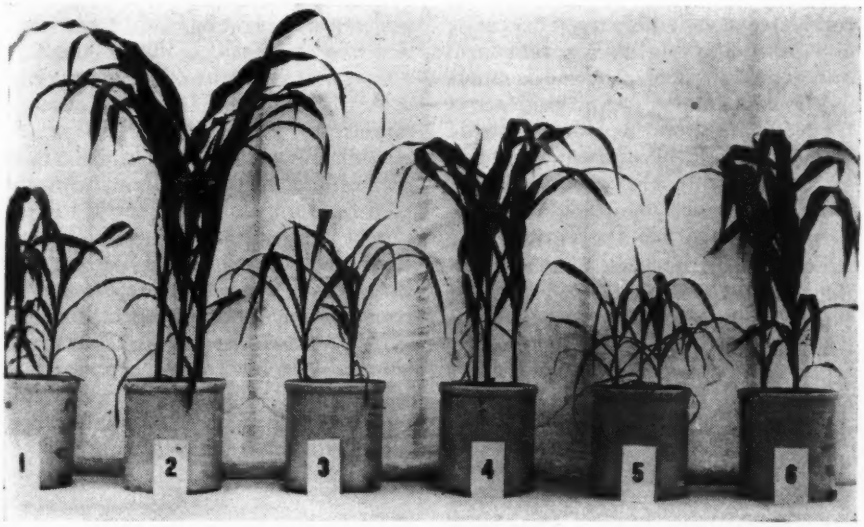

Fig. 1. The influence of nutrient treatment, moisture content, and compaction of a Clyde silt loam soil on the growth of corn.
Jar 1—NP fertilizer, 25% soil moisture, no compaction.
Jar 2—NPK fertilizer, 25% soil moisture, no compaction.
Jar 3—NP fertilizer, 50% soil moisture, no compaction.
Jar 4—NPK fertilizer, 50% soil moisture, no compaction.
Jar 5—NP fertilizer, 25% soil moisture, compaction.
Jar 6—NPK fertilizer, 25% soil moisture, compaction.

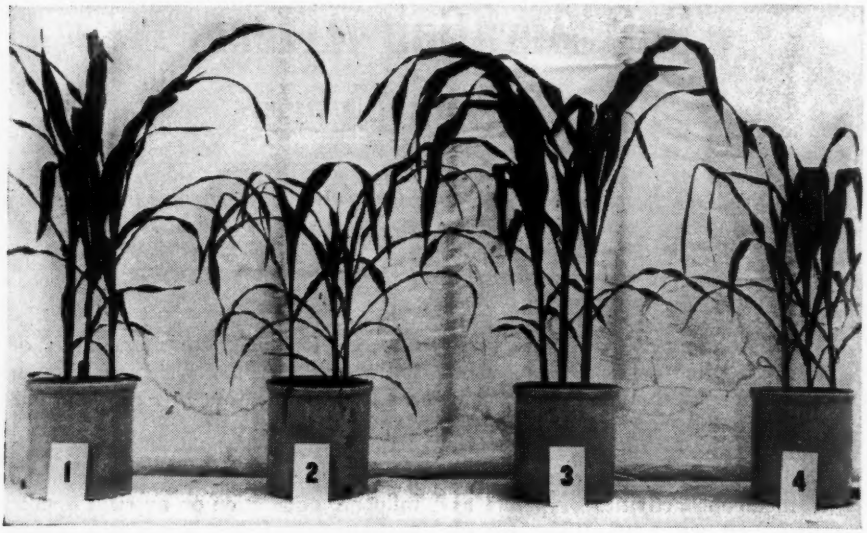

Fig. 2. The effect of compaction and nutrient treatment on corn grown on a Clarion loam soil at 15% moisture.

Jar 1—No compaction, NP fertilizer.
Jar 2—Compaction, NP fertilizer.
Jar 3—No compaction, NPK fertilizer.
Jar 4—Compaction, NPK fertilizer.

by plants. A recent study by Chang and Loomis (3), however, points out that carbon dioxide toxicity must be considered along with oxygen deficiency as a factor affecting plant development under conditions of poor soil aeration.

We would expect to find evidence of poor soil aeration in reduced yields, stunted growth, or nutrient deficiency of crops wherever the amount of functional pore space occupied by air has been reduced below the critical limit either by high moisture content or by the compaction of the soil through tillage operation or lack of it. Everyone has seen corn or beans or some other crop stunted in growth and yellowed when water has stood in the field for a week or more. Likewise it is quite surprising sometimes to see plants in these same waterlogged spots become green and produce good yields if the excess water is drained away fairly quickly. At other times plant functions may be interrupted for so long a time by lack of soil oxygen or the presence of high concentrations of carbon dioxide that the crop never regains full growth or dies.

A good deal of interest in the relation between soil aeration and tillage practice has been evoked in consideration of the relative merits of plowing versus subsurface tillage. Data and observations from several agricultural experiment stations indicate that in certain seasons and on some soils plowing for corn may be definitely superior to discing or subsurface tillage. Bower, Browning, and Norton (1) believe that the method of seedbed preparation for corn has an important effect on yield as the tillage operation affects soil aeration and in turn the absorption of soil nitrogen and potassium. Certainly plowing produces a seedbed which is looser and better aerated than the other practices mentioned.

On the other hand, compaction of the soil and reduction of total pore space by working the soil when too wet, by the continual use of heavy farm implements, or through the action of very heavy or beating rains might critically lower the soil air supply and limit

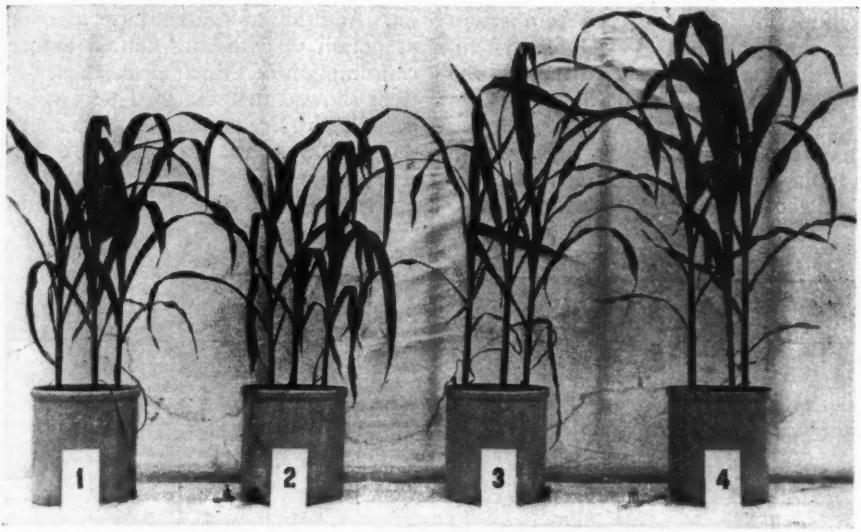

Fig. 3. The effect of forced aeration and nutrient treatment of corn grown on a Clarion loam soil at 40% moisture.

Jar 1—No aeration, NP fertilizer.
Jar 2—Aeration, NP fertilizer.
Jar 3—No aeration, NPK fertilizer.
Jar 4—Aeration, NPK fertilizer.

root penetration and respiration with resultant lowered crop yields. It has been suggested by Hoffer (5) that on some soils adequate nutrients may be present, but if soil aeration is a critical factor the response of crops to fertilizers may be very small.

The relation between the various forms of nitrogen in the soil and aeration conditions has long been recognized. By means of soil tests it is quite easy to demonstrate in the laboratory or field the conversion of ammonia nitrogen to nitrates when the oxygen supply in the soil is adequate. Recently the absorption of potassium by plants has been found to be directly related to aeration conditions in culture solution. Hoagland and Broyer (4) found that the uptake of potassium by barley plants could be closely correlated with the supply of oxygen. The influence of carbon dioxide toxicity on the reduction of absorption of nutrients, and potassium in particular, has been shown by Chang and Loomis (3) in their studies on maize plants.

To study the effect of soil aeration on the growth and absorption of nutrients by corn, greenhouse experiments were conducted recently at the Iowa Agricultural Experiment Station (6). The soils selected for study were a Clyde silt loam from a poorly drained field in northeastern Iowa and a Clarion loam from the central part of the State. Chemical analyses of the Clyde soils indicate a high content of available potassium, but additional potash in the form of fertilizer is generally needed to produce high yields of corn. This would indicate that although there there is a good supply of potash in the soil, some factor such as high soil moisture is limiting potassium absorption by the plant. Tillage studies on the Clarion soil in 1944 showed that severe potash deficiency occurred in corn plants on plots where subsurface tillage was practiced. On plots where plowing was used as the method of seedbed preparation, the corn was healthy and green.

A comparison of several degrees of soil aeration was obtained in three ways. Two moisture levels were used together

with two degrees of soil compaction or tamping and a forced air system. Fertilizers were added to half of the pots to see whether additions of potassium and phosphorus would help alleviate the effects of poor soil aeration. At the end of the experiment the tops and roots of the corn plants were harvested, dried, weighed, and the tops analyzed for total nitrogen, phosphorus, potassium, calcium, and magnesium.

As one might suspect, the size and weight of plant tops and roots were reduced as the soil moisture content was increased. The per cent of potassium in the plant, as indicated, decreased likewise. This was the case also for nitrogen and phosphorus. A small increase for calcium and magnesium was found in plants on the Clarion soil. The corn grown on the Clyde soil without potash fertilizer showed marked potassium starvation signs especially when soil aeration conditions were poorest. Addition of a rather large amount of potash to both soils caused luxury consumption of this element. Calculations showed that the total pore space occupied by air was reduced from about 35% to 0% at the high moisture content for the two soils.

Creating conditions of poor soil aeration by artificial soil compaction gave similar results. Yields were very low and resultant functional pore space was reduced almost completely when the soils were tamped.

Root development was less when the soils were tamped than when high soil moisture treatments were used. Since the pore space was lowered approximately to zero in both cases, it would indicate that root growth was limited in part by difficulties in penetrating the packed soil mass. Tamping the soil reduced the potassium content of the corn plants, but increased the ni-

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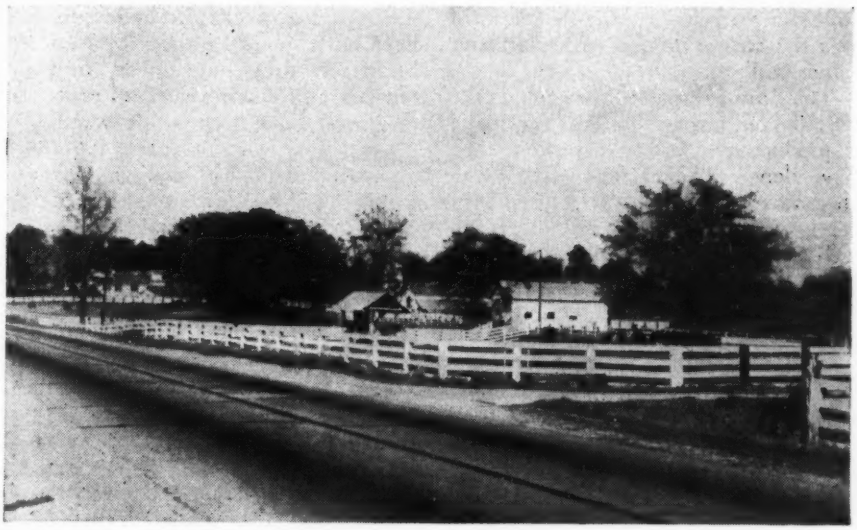
TABLE 1

Fertilizer treatment			NP	NPK	NP	NPK
	% soil moisture	% pore space occupied by air	Yield of tops in grams		% K in plant tops	
Clarion loam	15	37.1	20.8	24.6	2.10	3.15
	40	0.0	13.3	18.1	0.95	2.06
Clyde silt loam	25	30.4	7.4	24.7	0.95	4.68
	50	0.0	4.7	13.3	0.65	2.58

TABLE 2

Fertilizer treatment			NP	NPK	NP	NPK
	Soil treatment*	% pore space occupied by air	Yield of tops in grams		% K in plant tops	
Clarion loam	Normal	37.1	20.8	23.9	2.10	3.14
	Packed	1.0	8.7	10.7	0.81	2.85
Clyde silt loam	Normal	30.4	7.4	24.7	0.93	4.68
	Packed	0.2	2.6	10.8	0.80	2.80

*Clarion and Clyde soils were held at 15 and 25% soil moisture.



A general view of the Burton farmstead. Cattle and feed barns and silo in foreground, residence in background.

The Burtons Farm To Feed People

By Fred J. Hurst

Director of Information, Farm Credit Administration, New Orleans, Louisiana

IT'S a wonderful thing to reclaim, transform, and improve a run-down farm. It's reassuring to see eroded areas terraced, limed, fertilized, and sodded to grasses and clovers. It's an inspiration to see grain grow and cattle graze where weeds flourished. In a world where millions suffer from hunger, it's a good thing to farm more efficiently and produce more abundantly.

That is what W. L. Burton, a Jackson, Mississippi, businessman and his son, Billy, have done. Six years ago the Burtons bought an 800-acre farm near Jackson. This farm had been practically abandoned. It had been poorly farmed. The soil had been depleted. The hill land was eroded. The bottom land needed draining. There were no fences. The buildings were dilapidated. Practically the whole farm had grown up in worthless, limby trees, bushes, and briars.

Probably if Mr. Burton had been a full-fledged farmer he might have hesitated to tackle the job. But he operates a restaurant in Jackson. Having been raised on the farm, he had a yearning to get out in the wide-open spaces and get the smell of fresh air and wild flowers. He wanted to ride horses and see cattle grazing. And Billy had become tremendously interested in raising cattle. He wanted to engage in some challenging occupation and needed a

full-time managerial job. So the farm was the answer to the wishes of both father and son.

The Burtons believed they could take over the old farm, rebuild it, and make it productive. And that is what they have done. They have cleared away the briars and bushes. They have built terraces and filled in the gullies. They have stopped erosion and dug miles of ditches. They have put out limestone and added phosphate and applied potash. They have grown and plowed under soil-building legumes. They have built lush pastures. They have developed a magnificent herd of registered Hereford cattle. They have produced big crops of corn and oats and hay.

Drive south from Jackson on Highway 51 for about eight miles and you will see the Burton farm. There is a beautiful country home, big hay and cattle barns, white painted fences, lespedeza meadows, green pastures, grazing cattle.

But it has taken a realistic faith in the principles of agricultural science, a practical knowledge of the best farming practices, the assistance of agricultural agencies, the use of modern machinery, a considerable volume of capital and ready cash money, and a lot of hard work to bring about the transformation.

Sought Help

Realizing the need for the latest information on farming, Mr. Burton from the very beginning sought the help of his county agent, the Soil Conservation Service, the Agricultural Conservation Service, and other agricultural agencies and workers. He visited and studied other successful farms and attended meetings of the Jackson Farm Club.

The first things needed were clearing, terracing, and ditching. For this purpose, Mr. Burton contracted for a bulldozer and put this giant machine to work clearing the land, pushing up stumps, filling gullies, and digging ditches. For weeks the bulldozer was kept busy subduing the wilderness of bushes, blotting out gullies, forming terraces, and making the land ready for the plow. Four stock ponds were built.

Corn and oats for grain, lespedeza and soybeans for hay, and white clover, Dallis grass, and lespedeza for pasture, make up the cropping and pasture program. This system provides a protective covering for nearly every acre of land, produces cheap feed for livestock, permits use of labor-saving machinery, and reduces hand labor to a minimum.

This year there were 120 acres in oats, 80 acres of which were seeded to white clover and lespedeza for pasture, and 40 acres to lespedeza for hay. The land was thoroughly prepared, fertilized with 1,000 pounds of basic slag, 100 pounds of nitrate of soda, and 100 pounds of muriate of potash per acre, and seeded to 2½ bushels of certified oats per acre early in October. White clover was seeded on the oats in October and lespedeza planted in February. The oats were top-dressed with 200 pounds of nitrate of soda in February.

The 120 acres of oats were combined the last two weeks in May and yielded 5,000 bushels. On May 30 when I walked over the farm with Mr. Burton and Billy, the 80 acres of oat land which had been seeded for pasture was half knee-deep in white clover and lespedeza and the 40 acres of Kobe lespedeza, except in spots where the stand was sparse, promised to yield 1½ to 2 tons of hay per acre.

This combination of oats and lespedeza for grain and hay is one of the most economical ways to conserve soil fertility and produce feed cheaply. The oats cover the land during the winter and yield a grain crop in the spring. The lespedeza produces a dense growth that covers the ground, holds the topsoil, adds nitrogen and humus to the land, and produces a good feed crop in the fall.

Farmers who use this combination should remember that the oats need a liberal supply of nitrogen fertilizer.

Part of the Burton Hereford herd on permanent pasture.

The lespedeza responds wonderfully to applications of phosphate and potash, and these two elements should be applied in amounts needed.

We have never seen a more efficient job of oat harvesting than that witnessed on the Burton farm. The oats were combined, the straw was windrowed with a 12-foot, side-delivery rake and then baled with a one-man pickup baler, which turned out 1¼ bales per minute and covered 40 acres in a day. Lespedeza will be cut with a power-mowing machine, raked with a tractor-drawn, side-delivery rake, and baled with the one-man baler, which is a real

Fresh roasting ears and other wholesome vegetables are produced on the farm for direct sale to consumers.

labor-saver and enables the farmer to get his hay in the barn in a hurry and take advantage of favorable weather.

There are 60 acres in corn. Every effort is made to obtain high yields. The land is thoroughly prepared by plowing and harrowing. Hybrid seed are planted; 400 pounds of 6-8-8 fertilizer per acre are applied before planting and the corn is side-dressed with 200 pounds of nitrate of soda unless it follows a winter cover crop that was plowed under.

Soybeans are drilled in rows, fertilized with 200 pounds of 6-8-8 per acre, and cultivated two or three times. Heavy seeding, early planting, balanced fertilization, and clean cultivation are essential to good yields.

One of the most important and efficient jobs done on the Burton farm has been the establishment and improvement of permanent pastures. Neither labor nor money has been spared in building pastures which are now carrying up to one animal unit per acre. Every acre of hill land on the farm not in timber has been put in pasture. Nearly 500 acres of bottom land have been established to pasture.

Control of surplus water by terracing and drainage, addition of nitrogen and humus to the soil by plowing under a crop of vetch in the spring and a crop of crotalaria in the fall, thorough preparation of the seed-bed by plowing and harrowing until the soil was finely pulverized, application of two tons of limestone and fertilization with 400 to 600 pounds of 20 per cent superphosphate and 200 pounds of muriate of potash per acre, and heavy seeding were practices followed in building highly productive permanent pastures.

Mr. Burton found heavy seeding important. He seeded 10 pounds of white clover and 30 pounds of Dallis grass per acre in October and 30 pounds of lespedeza in February. This is about double the usual rate of seeding, but these amounts have proved profitable in getting a thick stand and in establishing a heavy sod of grasses and clovers, which has crowded out other plants and withstood heavy grazing without impairing the stand.

In addition to using plenty of mineral fertilizers, Mr. Burton says, "I have some spots which I have to manure and reseed. This added fertilization and seeding are necessary to build up

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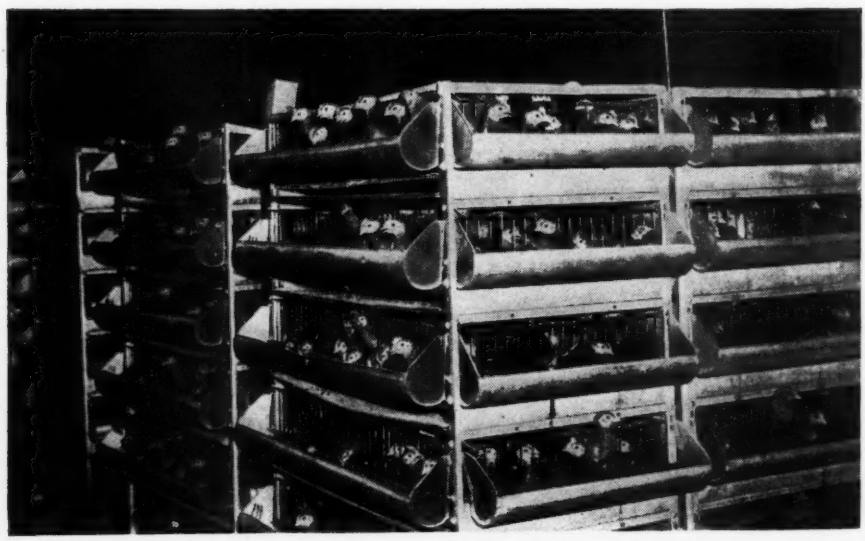

Showing some of the 4,000 broilers produced each month on the Burton farm.

Tip-Burn-Like Condition in Greenhouse Lettuce Corrected By Borax

By E. E. Greer

Williamson County Agent, Marion, Illinois

IN the Spring of 1944 the author was asked to assist two Williamson County greenhouse operators who reported peculiar symptoms in leaf lettuce appearing just at marketing time. This lettuce showed a necrotic tissue near the leaf margin and over the growing point. The plants seemed to have thick, small-cupped, brittle leaves. The leaves then browned and death resulted at the growing point. The lettuce leaves seemed brittle and in handling gave a metallic, rustling, paper-like noise.

The soil samples taken from the greenhouses showed that as far as nitrogen, phosphorus, and potassium were concerned they were sufficient for good growth of the lettuce. The management of the greenhouses was carefully checked and found to be satisfactory.

According to J. S. McHarque and R. K. Calfee in reporting on the effects of boron on the growth of lettuce in Plant Physiology, Volume VII of 1932, a similar condition existed in boron-deficient head lettuce plants. A. D. Moinat, in Plant Physiology, Volume XVIII of 1943, reported the thickening and the cupping-like condition on lettuce grown in nutrient solutions without boron.

Soils in Illinois have shown boron deficiencies in several soil types. Alfalfa was found to be sensitive and has responded to boron in southern Illinois.

The soil in these greenhouses has been used consistently for more than 30 years. It is the highly weathered type common to southern Illinois and is one expected to be low in available boron for alfalfa and other legume crops. Previous to 1935 manure from the livestock yards at East St. Louis had been applied at the rate of 100 tons per acre. For the last 10 years manure produced on their own farms has been used. Since the farm soil is probably low in available boron, the feeds produced and fed to the livestock are likewise low. This soil had been producing three crops of lettuce yielding 50 to 60 tons per acre and tomatoes yielding from 20 to 30 tons which has caused a heavy withdrawal of boron so that a deficiency for lettuce was created.

Followed Recommendations

Mr. Ridgway, owner of one of the greenhouses, followed the author's recommendations and applied 30 pounds of borax per acre in the greenhouse unit in which the tip-burn-like condition appeared to be worse. The borax was applied ahead of the second planting. The results of this simple and single treatment were phenomenal. At harvest time the total yield of the previous crops increased from 10 tons to a yield of 20 tons per acre. The leaves yielded their normal green growth throughout the harvest without even a trace of the tip-burn condition.

Mr. Greer followed the instructions

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The long runners of Tropical kudzu enable it to thrive beneath trees in spite of competition with the trees for water and nutrients. In times of stress evidently the kudzu foliage under trees is supported by distant roots. Photo was taken six months after seeding.

Tropical Kudzu

By Emery A. Telford and Norman F. Childers[1]

Soil Conservation Service, U. S. Department of Agriculture, Mayaguez, Puerto Rico

THE kudzu (*Pueraria thunbergiana*) which is popular in the southern United States does not grow well in Puerto Rico or countries of similar climate. However, tropical kudzu, a close relative, is adapted to the soil and climatic conditions in Puerto Rico and is proving highly satisfactory.[2] It is filling a long-time need for a vigorous perennial legume which covers the ground thoroughly and quickly from seed, thus helping to control hill-side and gully erosion and at the same time adding organic matter and nitrogen to the soil.

The vine-like legume has several other qualities. It is relatively resistant to drought; grows well in full sun and beneath trees of moderate shade; has no serious insects or diseases; makes good pasture for dairy cows in Puerto Rico; and produces abundant seed, from which it is easily established. The legume tends to spread from an original planting when seeding is permitted, but it can be destroyed easily by plowing or cultivating. There is no danger of it becoming a pest on cultivated lands

[1] Mr. Telford is in charge of Observational Studies for the U. S. Soil Conservation Service, Mayaguez, Puerto Rico. Mr. Childers is Assistant Director, Federal Experiment Station, Office of Experiment Stations, U. S. Department of Agriculture, Mayaguez, Puerto Rico.

[2] Tropical kudzu seed was brought to Puerto Rico in 1940 by Dr. W. F. Stewart, Boyce Thompson Institute, Yonkers, New York, from The Rubber Research Institute of Malaya. The seed supply was increased by H. W. Alberts, former agronomist in charge of Soil Conservation Service Research Station, Río Piedras, Puerto Rico. Tropical kudzu was originally thought to be Wild Cowpea *(Vigna vexillata)* but later identified as *Pueraria phaseoloides (javanica)* Benth. by F. J. Herman, Associate Botanist, Division of Plan Exploration and Introduction, U. S. Department of Agriculture.

and it forms a valuable permanent cover on uncultivated lands.

Tropical kudzu is a common crop in Java, Sumatra, Malay, and neighboring countries where it is used as a ground cover while young rubber and cinchona plantations are becoming established. The Firestone Plantations Company in Liberia, West Africa, reports several thousand acres of this cover crop in their young rubber plantations. In the Indio-Rubber Journal of April 6, 1940, Ashplant reports a reduction in root rot of rubber trees where this plant was used as a cover crop in Sumatra.

The crop has been grown only since 1940 in Puerto Rico but has already proven itself superior to other legumes and many grasses at the Federal Experiment Station. Its trailing runners may extend from 20 to 30 feet up and down banks, under trees, and over grasses and weeds until most undergrowth, such as nut-grass, is smothered by the dense mat of runners and dead leaves. When planted among young trees, it has a tendency to climb the trunks, but the runners can be removed at two- or three-month intervals, and the labor is much less than that required to cut with a machete the natural growth of the entire area.

Not Exacting in Soils

Tropical kudzu is not particularly exacting in soil requirements. At the Station it is growing and flowering luxuriantly on heavy excavated clay soil. In a Catalina clay soil (pH 4.5) the roots were found penetrating to at least 4½ feet. No doubt this accounts for its ability to continue growing slowly during extended dry periods when other legumes, such as Trailing Indigo, show considerable distress. It has grown on poorly drained, compact clay loam and also on porous soils of a calcareous nature.

Fertilizer experiments on eroded or excavated soils revealed that young seedlings were stimulated by an appli-

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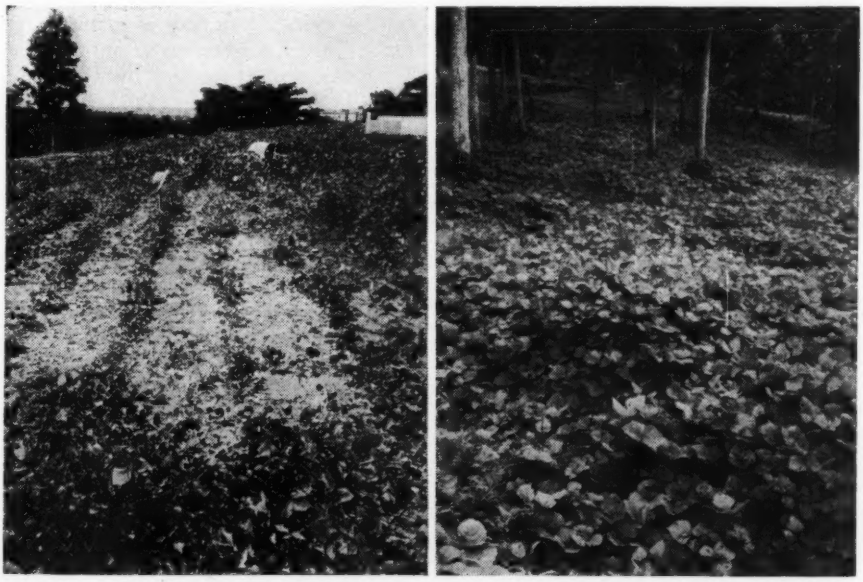

Left—A fertilizer experiment on excavated Catalina clay soil revealed that lime alone (poor growth this side of hat) and muriate of potash (plot beyond hat) had little effect on growth of kudzu seedlings, whereas complete fertilizer (background and immediate foreground) gave the seedlings a good start, as did the finely ground superphosphate (right). A complete fertilizer is recommended for seedlings and a month after planting, if the soil pH is below 6.0, lime also should be applied.

The Use of Caley Peas in Alabama's Black Belt

By Kenneth B. Roy

Editor, Agricultural Experiment Station, Auburn, Alabama

WHEN A. F. Caley walked through an old cotton field on his dairy farm near Marion Junction, Alabama, one late spring morning in 1935, little did he realize that he was to find a legume that was later to become a favored forage crop with stockmen in the Alabama Black Belt.

It was *Lathyrus hirsutus,* commonly known as rough peavine, wild winter pea, or Singletary pea. Years before it had been discarded as a soil-builder because it produced green matter too late in the season to be followed in a rotation by most row crops. In the Southeast it now bears the name of Caley because of Mr. Caley's interest in its potentialities as a forage plant.

Experiments to determine how to grow and manage Caley peas as a forge plant since 1937 at the Alabama Agricultural Experimental Station's 1,100-acre Black Belt Substation adjoining Mr. Caley's farm have revealed that the crop is particularly suited in that section to forage-growing systems supporting livestock production.

Experimental Results

In early trials, begun the fall of 1937, Caley peas were placed in plots on lime soils of the Substation to determine best production methods. The crop was treated similarly to vetch, being planted on a good seedbed at the rate of 20 pounds per acre about the middle of September. It became apparent, after obtaining poor results from this treatment, that reasonably good stands might be expected from planting on a firm seedbed at about double the original rate of seeding.

With the discovery of the best cultural methods, Caley peas were planted on a 15-acre field in 1939. This field is still in production and continues to have good stands of peas without any additional seeding or cultivation. Later other areas were seeded for further experiments to determine the best uses, methods of handling, and combinations with other crops.

Out of this work has come a system of grazing that combines Johnson grass and Caley peas. Previously, the Substation had developed a method for using Johnson grass as a supplement to permanent pastures in times of drought and as a hay and grazing crop. In combining the two, it was discovered that the peas greatly increased Johnson grass yields, even more so than the spring clovers. Also, the combination extended the grazing of the areas.

Limited tests show that, if they are harvested before blooming and seeding stage, Caley peas may become an important source of legume hay in the region. Results from experiments at the Substation also indicate the possibility of Caley peas being grown in rotation with grain sorghum, and in combination with Dallis grass or fall oats. However, farmers are cautioned against this latter combination, unless they are willing to go to the expense of separating the oats and pea seed. If the combination is to be used as a hay crop, the Caley peas and oats are harvested before the Caley peas bloom.

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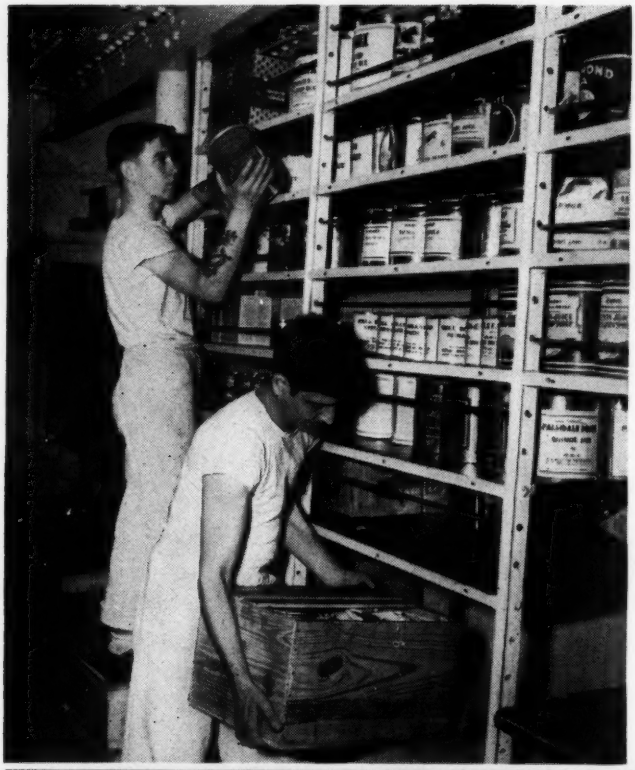
PICTORIAL

Official U. S. Navy Photograph

Aboard this small Navy craft which served in the Pacific as a "floating ice cream parlor," the skipper had a victory garden which gave him a personal supply of fresh tomatoes, radishes, and lettuce.



Left: Cleanliness and neatness are "musts" in the Navy. Here men are stacking canned goods in orderly rows on shelves.

Below: Perishable supplies are stacked under cover on ship for rigid Navy inspection before being sent below.

Official U. S. Navy Photographs

Above: This turkey made a long trip across the Pacific in order that these Navy men could have a real American Thanksgiving dinner.

Below: Chow line and water line, as Seabees attend to the "inner man" while getting the "outer man" good and wet on Guadalcanal.

Official U. S. Navy Photographs

Above: American agriculture went to the conquered soils of the Mariannas to furnish fresh vegetables to men on the fronts and in hospitals.

Below: Purebred cattle, 85 of them, were among the early arrivals for the Navy-Foreign Economic Administration farm on Guam.

Official U. S. Navy Photographs

The Editors Talk

A Self-sustaining Agriculture

In an address before the U. S. Chamber of Commerce at Atlantic City in April, Secretary of Agriculture Clinton P. Anderson defined a self-sustaining agriculture as an agriculture in which farmers will be on a level with all other American groups and be able to work with business and labor on equal terms for the benefit of all. He elaborated with six points:

1. It would stand on its own feet, operating at a fair level of profit without benefit of consumer subsidies, price controls, or continuous price supports or income payments.

2. It would operate on a basis of sustained yield, not obtaining current production and income through drains on future productivity. Under a self-sustaining agriculture, farmers will put back into the soil each year at least as much fertility as they take out.

3. It would operate on the basis of a price level that is at least reasonably stable. Farmers need assurance that the bottom is not going to drop out suddenly from under their prices and income.

4. It would offer reasonable assurance of an adequate living to the families who depend wholly on farming for their incomes.

5. It would operate with as little interference to the actions of individuals as is consistent with the welfare of farmers and the rest of the Nation. There will be times, of course, when common action clearly is in the general interest.

6. A self-sustaining agriculture must not only meet the needs of farm people, but also the needs of the rest of the Nation by supplying adequate supplies of foods and fibers and good markets for the products of industry.

Secretary Anderson then summarized briefly just what our agriculture is today: We no longer are the Nation of farmers we used to be. Just 18% of the total population—less than one person out of five—is on the land today. Yet that makes a total of more than 25 million men, women, and children who make their direct living from the soil. These families operate more than 6 million farms, ranging from vast ranches of thousands of acres down to intensively farmed vegetable enterprises of an acre or so—but also including farms that are too small and too poor to yield even the hardest working family a decent living. These farm people are the custodians of a total of 1,943,000,000 acres of our land—the greatest, richest agricultural empire in the world. Last year they harvested more than a billion bushels of wheat, 3 billion bushels of corn, 1½ billion bushels of oats, and 190 million bushels of soybeans. They milked nearly 26 million cows; they gathered eggs from 469 million hens; they had 40 million beef cattle on the range and in feed lots. Today's agriculture is a 90 billion dollar industry—that is how much its assets are estimated to be worth. In 1945 it produced more than 20 billion dollars of cash receipts for farmers.

Inspiring figures in which every American can feel pride! But the Secretary did not let it go at that. Touching on what happened to agriculture after the last war and during the depression, he outlined some of the problems ahead. He believes that the first prerequisite of a self-sustaining agriculture is Nation-wide full employment, but that even full employment in itself will not be enough to guarantee a strong and prosperous agriculture. Agriculture's capacity to produce may still run ahead of amounts people can buy. People in this country and abroad undoubtedly could use all that U. S. farmers will produce in the foreseeable future; but even in this country many families with the lower-paying jobs would not be able to purchase all the food and clothing they ought to have. The fact that there is a potential market for total farm production does not mean automatically there will be a market for as much of each separate commodity as farmers could turn out. To a certain extent, the pattern of farm production needs to be shaped to the pattern of potential demand.

He thinks that some parts of the job of maintaining the Nation's soil resources will still be too much for farmers acting as individuals. Also, that the constant research into better production and marketing methods, which all large industries must carry out, undoubtedly will be too much for individual farmers or even groups of farmers. Agriculture still will need special machinery for carrying adequate reserves of storable foods, feeds, and fibers from bumper years to years of lean production.

In concluding his address, Secretary Anderson told his audience that he hoped he had given them something of the picture he had of the possibilities for a self-sustaining agriculture. "We can achieve it only by give-and-take cooperation by labor, industry, farmers, and government. . . . You may be sure that farmers are ready and eager to do their part."

We believe his picture is well-drawn and offers enlightenment, not only to farmers but to all Americans, on the benefits to be derived from a self-sustaining agriculture.

TO THE FARMERS OF AMERICA:

In September, 1945, the Japanese surrendered. I regard it as significant that they surrendered during the harvest month, for, no less than the guns and the spirit of our men and women, it was the food which came from the great farming areas of this country that brought us to victory.

The Navy still remembers the heroic work of the farmers, who, although it is more than a year since the fighting ended, have not lessened their efforts to feed the nation and the starving peoples of the world. On Navy Day, October 27, 1946, I wish to thank the farmers of America.

JAMES FORRESTAL

Thus has the Secretary of the Navy acknowledged his gratitude and debt to his country's food producers. It is a nice tribute, and fitting, for it is generally known that food is one of the strongest weapons and that American service men were the best fed of any in the war. For some pictures showing the Navy's utilization of the food provided them, see the pictorial section of this issue.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1920	15.9	17.3	125.3	141.7	61.8	182.6	16.46	25.65	....
1921	17.0	19.5	113.3	113.1	52.3	103.0	11.63	29.14	....
1922	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944	20.7	40.8	149.0	192.0	109.0	141.0	16.40	52.70	....
1945									
September	21.72	43.2	138.0	207.0	112.0	145.0	14.30	51.40	....
October	22.30	45.9	126.0	180.0	113.0	151.0	14.30	51.00	....
November	22.52	46.7	131.0	186.0	111.0	153.0	14.90	51.30	....
December	22.84	43.8	137.0	194.0	109.0	154.0	15.40	51.40	....
1946									
January	22.36	36.3	145.0	208.0	110.0	154.0	15.70	50.90	....
February	23.01	33.9	146.0	223.0	111.0	155.0	15.80	50.30	....
March	22.70	31.9	157.0	236.0	114.0	158.0	16.30	47.50	....
April	23.59	42.9	162.0	245.0	116.0	158.0	15.00	48.00	....
May	24.09	43.0	157.0	251.0	135.0	170.0	14.80	49.60	....
June	25.98	59.0	147.0	251.0	142.0	174.0	14.70	51.50	....
July	30.83	56.7	148.0	275.0	196.0	187.0	15.00	60.00	....
August	33.55	48.6	143.0	280.0	180.0	170.0	15.10	59.10	....
Index Numbers (Aug. 1909—July 1914=100)									
1920	128	173	180	161	96	207	139	114	....
1921	137	195	163	129	81	117	98	129	....
1922	185	228	95	114	116	109	98	135	....
1923	231	190	133	137	129	105	110	183	....
1924	185	190	98	170	166	141	107	147	143
1925	158	168	245	188	109	163	108	140	143
1926	101	179	189	134	116	138	112	98	139
1927	163	207	146	124	132	135	87	154	127
1928	145	200	76	134	131	113	95	152	154
1929	135	183	189	133	124	117	92	137	137
1930	77	128	131	123	93	76	93	98	129
1931	46	82	66	83	50	44	73	40	115
1932	52	105	55	62	50	43	52	46	102
1933	82	130	118	79	81	84	68	57	91
1934	100	213	64	91	127	96	111	146	95
1935	90	184	85	80	102	94	63	135	119
1936	100	236	164	106	163	116	94	148	104
1937	68	204	76	93	81	109	74	87	110
1938	69	196	80	83	76	64	57	97	88
1939	73	154	100	85	88	78	67	94	91
1940	80	160	78	97	96	77	64	96	111
1941	137	264	116	107	117	107	81	211	129
1942	153	369	168	136	143	124	91	202	163
1943	160	405	188	232	174	154	125	231	245
1944	167	408	214	219	170	160	138	234	212
1945									
September	175	432	198	236	174	164	120	228	159
October	180	459	181	205	176	171	120	226	181
November	182	467	188	212	173	173	126	227	235
December	184	438	197	221	170	174	130	228	223
1946									
January	180	363	208	237	171	174	132	226	249
February	186	339	209	254	173	175	133	223	275
March	183	319	225	269	178	179	137	211	283
April	190	429	232	279	181	179	126	213	282
May	194	430	225	286	210	192	125	220	177
June	210	590	211	286	221	197	124	228	185
July	249	567	212	313	305	212	126	266	163
August	287	486	205	319	280	192	127	262	162

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945						
September	1.75	1.42	7.81	5.77	4.86	6.71
October	1.75	1.42	7.81	5.77	4.86	6.71
November	1.75	1.42	7.81	5.77	4.86	6.71
December	1.75	1.42	7.81	5.77	4.86	6.71
1946						
January	1.75	1.42	7.81	5.77	4.86	6.71
February	1.75	1.42	7.81	5.77	4.86	6.71
March	1.75	1.42	7.81	5.77	4.86	6.71
April	1.75	1.42	7.81	5.77	4.86	6.71
May	1.75	1.42	9.08	6.10	4.86	7.30
June	1.88	1.42	10.34	6.42	4.86	7.90
July	1.88	1.42	11.62	8.15	5.34	9.60
August	2.22	1.46	17.15	8.14	6.07	12.14
Index Numbers (1910-14=100)						
1922	113	90	173	132	140	142
1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945						
September	65	50	223	163	144	191
October	65	50	223	163	144	191
November	65	50	223	163	144	191
December	65	50	223	163	144	191
1946						
January	65	50	223	163	144	191
February	65	50	223	163	144	191
March	65	50	223	163	144	191
April	65	50	223	163	144	191
May	65	50	259	173	144	207
June	70	50	295	182	144	224
July	70	50	332	231	158	273
August	83	51	490	231	180	345

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1922	.566	3.12	6.90	.632	.904	23.87	....
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	....
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.570
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945							
September	.650	2.20	6.20	.503	.749	24.44	.188
October	.650	2.20	6.28	.535	.797	26.00	.200
November	.650	2.20	6.40	.535	.797	26.00	.200
December	.650	2.20	6.40	.535	.797	26.00	.200
1946							
January	.650	2.20	6.40	.535	.797	26.00	.200
February	.650	2.20	6.40	.535	.797	26.00	.200
March	.650	2.20	6.40	.535	.797	26.00	.200
April	.650	2.20	6.40	.535	.797	26.00	.200
May	.650	2.20	6.40	.535	.797	26.00	.200
June	.650	2.30	6.45	.471	.729	22.88	.176
July	.650	2.60	6.60	.471	.729	22.88	.176
August	.700	2.60	6.60	.471	.729	22.88	.176
			Index Numbers (1910-14=100)				
1922	106	87	141	89	95	99	....
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945							
September	121	61	127	70	79	101	82
October	121	61	129	75	84	108	83
November	121	61	131	75	84	108	83
December	121	61	131	75	84	108	83
1946							
January	121	61	131	75	84	108	83
February	121	61	131	75	84	108	83
March	121	61	131	75	84	108	83
April	121	61	131	75	84	108	83
May	121	61	131	75	84	108	83
June	121	64	132	66	76	95	80
July	121	72	135	66	76	95	80
August	131	72	135	66	76	95	80

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1922	132	149	141	116	101	145	106	85
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	150	94	57	160	117	77
1944	195	176	151	96	57	174	120	76
1945								
September	197	181	153	96	57	175	121	74
October	199	182	154	97	57	175	121	78
November	205	182	156	97	57	175	121	78
December	207	183	156	97	57	175	121	78
1946								
January	206	184	156	97	57	175	121	78
February	207	185	156	97	57	175	121	78
March	209	187	158	97	57	175	121	78
April	212	188	160	97	57	175	121	78
May	211	192	162	99	57	189	121	76
June	218	196	163	100	60	203	121	70
July	244	209	181	103	60	230	121	70
August	249	214	187	116	67	296	131	70

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Since June 1941, manure salts are quoted F.O.B. mines exclusively.

**** The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Two-Row Distributor for Commercial Fertilizer," Ext. Serv., Texas A. & M. College, College Station, Texas, L-45, R. R. Hickerson.

"Smith County Homemade Lime and Phosphate Distributor," Ext. Serv., Texas A. & M. College, College Station, Texas, L-47, M. R. Bentley.

"Fertilizers for White Potatoes in the High Plains of Texas," Agr. Exp. Sta., A. & M. College, College Station, Texas, P. R. 989, Feb. 27, 1946, D. L. Jones.

"The Effects of Boron on Yield and Quality of Bright Tobacco," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 395, May 1946, E. M. Matthews and M. N. McVickar.

"Fertilizers and Lime in the United States, Resources, Production, Marketing, and Use," U.S.D.A., Washington, D. C., Misc. Publ. 586, May 1946.

"Preparation of Ammonium Nitrate for Use as a Fertilizer," U.S.D.A., Washington, D. C., T. Bul. 912, June 1946, W. H. Ross, J. R. Adams, J. Y. Yee, C. W. Whittaker, and Katharine S. Love.

Soils

"Land Clearing," Dom. of Canada, Dept. of Agr., Ottawa, Can., Publ. 739, F. B. 111, March 1946 (Rev.), P. O. Ripley, J. M. Armstrong, and W. Kalbfleisch.

"Effects of Soil Treatment on Soil Productivity," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 516, Dec. 1945, F. C. Bauer, A. L. Lang, C. J. Badger, L. B. Miller, C. H. Farnham, P. E. Johnson, L. F. Marriott, and M. H. Nelson.

"Soil Studies for 1945," Agr. Exp. Sta., Univ. of Nebraska, Lincoln, Neb., Bul. 382, May 1946, J. W. Fitts, J. R. McHenry, and W. H. Allaway.

"Grass Down Field Waterways," Ext. Serv., Univ. of Neb., Lincoln, Neb., E. C. 165, May 1946, D. E. Hutchinson.

"The Soil, Virginia's Basic Resource," State Soil Conserv. Committee, Blacksburg, Va., Rept. No. 3, Oct. 1945.

"Economic Land Classification of Southampton County," Agr. Exp. Sta., Va. Polytechnic Institute, Blacksburg, Va., Bul. 373, Aug. 1945, G. W. Patteson and S. C. Shull.

"Economic Land Classification of Shenandoah County," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 376, Sept. 1945, G. W. Patteson and S. C. Shull.

"Economic Land Classification of Augusta County," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 377, Sept. 1945, G. W. Patteson and J. A. McCartney.

"Economic Land Classification of Culpeper County," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 379, Oct. 1945, G. W. Patteson and A. J. Harris.

"Economic Land Classification of New Kent County," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 380, Nov. 1945, G. W. Patteson and J. A. McCartney.

"Economic Land Classification of Charles City County," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 381, Nov. 1945, G. W. Patteson and J. A. McCartney.

"Economic Land Classification of Botetourt County," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 385, Dec. 1945, G. W. Patteson and J. A. McCartney.

"Economic Land Classification of Loudoun County," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 387, Jan. 1946, G. W. Patteson and S. C. Shull.

"Economic Land Classification of Hanover County," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 391, March 1946, G. W. Patteson and A. J. Harris.

"Relation of Soil Reaction to Toxicity and Persistence of Some Herbicides in Greenhouse Plots," U.S.D.A., Washington, D. C., T. Bul. 911, Aug. 1945, Annie M. Hurd-Karrer.

"Investigations in Erosion Control and Reclamation of Eroded Sandy Clay Lands of Texas, Arkansas, and Louisiana at the Conservation Experiment Station, Tyler, Texas, 1931-40," U.S.D.A., Washington, D. C., T. Bul. 916, June 1946, J. B. Pope, J. C. Archer, P. R. Johnson, A. G. McCall, and F. G. Bell.

"Physical Land Condition in Anderson County, South Carolina," U.S.D.A., Washington, D. C., Phys. Land Survey No. 38.

Crops

"Practices Used in the Production, Canning, and Marketing of Northwestern Arkansas To-

matoes in 1940-41," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 460, Oct. 1945, Otis T. Osgood and T. R. Hedges.

"Second Annual Irrigated Pasture Study Colusa County 1945," Ext. Serv., Univ. of Calif., Berkeley, Calif., B. B. Burlingame and G. E. Frevert.

"Establishment and Maintenance of Turf on Putting and Bowling Greens," Div. of Forage Crops, Dom. Exp. Farms Serv., Central Exp. Farm, Ottawa, Can., J. H. Boyce.

"The Care of Lawns," Div. of Forage Crops, Dom. Exp. Farms Serv., Central Exp. Farm, Ottawa, Can., J. H. Boyce.

"The Construction of New Lawns," Div. of Forage Crops, Dom. Exp. Farms Serv., Central Exp. Farm, Ottawa, Can., J. H. Boyce.

"Orchard Irrigation in British Columbia," Dom. of Can. Dept. of Agr., Ottawa, Can., Publ. 779, F. B. 134, June 1946, J. C. Wilcox.

"Tree Fruits Grown in Prairie Orchards," Dom. of Can. Dept. of Agr., Ottawa, Can., Publ. 780, F. B. 135, March 1946, W. R. Leslie.

"High Altitude Forage Investigations in Southwestern Colorado," Agr. Exp. Sta., Colo. A. & M. College, Fort Collins, Colo., Bul. 490, Jan. 1946, Dwight Koonce.

"Thirty-seven Years of Windbreak Planting at Akron, Colorado," Agr. Exp. Sta., Colo. A. & M. College, Fort Collins, Colo., Bul. 492, March 1946, R. J. Preston, Jr. and J. F. Brandon.

"Annual Report of the Director, 1945," Agr. Exp. Sta., Univ. of Del., Newark, Del., Bul. 259, Nov. 1945.

"Annual Report, 1945," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla.

"Chemical Composition of Hay and Forage Crops As Affected by Various Soil Treatments," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 518, H. J. Snider.

"Report on Agricultural Research, Part I: Project Reports, Publications, Staff Financial Statement; Part II: Iowa Corn Research Institute Tenth Annual Report," Agr. Exp. Sta., Iowa State College, Ames, Iowa.

"Size of Whole and Cut Seed and Spacing in Relation to Potato Yields," Agr. Exp. Sta., Univ. of Me., Orono, Me., Bul. 439, Dec. 1945, J. A. Chucka, Arthur Hawkins, Bailey E. Brown, and F. H. Steinmetz.

"Gardening for 12 Months," Ext. Serv., Miss. State College, State College, Miss., Cir. 134(30M), Feb. 1946, K. H. Buckley.

"The Agricultural Experiment Station Serves the Farmer," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 490, July 1945, M. F. Miller, S. B. Shirky, and H. J. L'Hote.

"59th Annual Report," Agr. Exp. Sta., Univ. of Nebraska, Lincoln, Neb., June 1946.

"What is Certified Seed?" Ext. Serv., Univ. of Neb., Lincoln, Neb., E. C. 167, D. L. Gross.

"Science for the Farmer," Sup. to 58th A. R., Agr. Exp. Sta., Pa. State College, State College, Pa., May 1946, B. L. Seem and A. C. Richer.

"Report of the Federal Experiment Station in Puerto Rico 1945," Federal Exp. Sta in P. R., Mayaguez, P. R.

"Swords into Plowshares," Ext. Serv., R. I. State College, Kingston, R. I., Bul. 103, March 1946.

"More Money From Cotton," Ext. Serv., Clemson Agr. College, Clemson, S. C., Cir. 280, March 1946.

"Northern Plant Novelties for 1946," Agr. Exp. Sta., S. Dak. State College, Brookings, S. Dak., H. Pamph. 34, March 1, 1946.

"Abstracts of Bulletins Nos. 663-677, Circulars Nos. 106-108, And Other Publications During 1945," Agr. Exp. Sta., A. & M. College, College Station, Texas, Cir. 109, Feb. 1946, Tad Moses.

"Forage and Seed Yields of Sorghum Varities," Agr. Exp. Sta., A. & M. College, College Station, Texas, P. R. 991, March 6, 1946, J. R. Quinby.

"Main Station Farm Cotton Variety Test for 1945," Agr. Exp. Sta., A. & M. College, College Station, Texas, P. R. 992, March 8, 1946, J. E. Roberts and D. T. Killough.

"More Wheat," Ext. Serv., State College of Washington, Pullman, Wn., Cir. 101, June 1946.

White Burley Tobacco Production," Ext. Serv., W. Va., Univ., Morgantown, W. Va., Cir. 346A, Feb. 1946, Charles E. Campbell.

"White Burley Tobacco Production," Ext. Serv., W. Va. Univ., Morgantown, W. Va., Cir. 346B, Feb. 1946, Charles E. Campbell.

"Savory Herbs, Culture and Use," U.S.D.A., Washington, D. C., F. B. 1977, May 1946, M. S. Lowman and Miriam Birdseye.

"Production and Preparation of Horseradish," U.S.D.A., Washington, D. C., Leaf. 129, (Rev. Feb. 1946), W. R. Beattie.

"Report on the Agricultural Experiment Stations, 1945," U.S.D.A., Washington, D. C., Jan. 1946, J. T. Jardine, G. Adams, F. Andre, H. P. Barss, E. C. Elting, F. W. Fromme, F. G. Harden, H. C. Knoblauch, F. V. Rand, H. M. Steece, R. W. Trullinger, J. W. Wellington, and B. Youngblood.

Economics

"Father and Son Farm Agreements," Agr. Exp. Sta., Colo. A. & M. College, Fort Collins, Colo., Bul. 491, March 1946, R. T. Burdick.

"The Operations and Management of 13 Farmers' Cooperatives in North Georgia, 1944," Ga. Exp. Sta., Experiment, Ga., Bul. 246, May 1946, N. M. Penny.

"Farming Opportunities in the Midwest," Agr. Ext. Serv., Purdue Univ., Lafayette, Ind., Bul. 325, 1946.

"The Kansas Agricultural Outlook for 1946," Ext. Serv., Kansas State College, Manhattan, Kansas, Cir. 190, Dec. 1945.

"Cooperative Association Law of Maryland," Ext. Serv., Univ. of Md., College Park, Md., Bul. 110, Feb. 1946, R. P. Callaway and S. H. DeVault.

"Postwar Readjustments in Massachusetts Agriculture," Agr. Exp. Sta., Mass. State Col-

lege, Amherst, Mass., Bul. 430, March 1946, David Rozman.

"Michigan Farm Organization and Practices Type-of-Farming Area 9," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Sp. Bul. 336, Feb. 1946, Lauren H. Brown.

"Facts About Flathead County's Agriculture and Suggestions to Prospective Farmers," Mont. Ext. Serv., Bozeman, Mont., Cir. 163, Dec. 1945.

"Relationships Between Cooperative Organizations Serving Farmers in Five Ohio Counties," Agr. Exp. Sta., Wooster, Ohio, Bul. 660, March 1946, G. F. Henning and L. B. Mann.

"Looking Forward in Oklahoma Agriculture," Div. of Agr., Okla. A. & M. College, Stillwater, Okla., Bul. B-299, June 1946.

"Looking Forward in Oklahoma Agriculture," Div. of Agr., Okla. A. & M. College, Stillwater, Okla., Cir. C-123, June 1946.

"Farming in West Virginia," Agr. Ext. Serv., Univ. of W. Va., Morgantown, W. Va., Cir. 345, Feb. 1946, Robert S. Boal.

"The Land Market," U.S.D.A., Washington, D. C., May 1946.

"Farm Population Estimates United States and Major Geographic Divisions 1910-1946," U.S.D.A., Washington, D. C., June 1946.

"Fruits (13 Noncitrus) Production and Utilization 1934-45," U.S.D.A., Washington, D. C., June 1946.

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"Changes in Farming in War and Peace," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., FM-58, June 1946, Sherman E. Johnson.

"World Food Prospects for 1946-47," Office of Foreign Agr. Relations, U.S.D.A., Washington, D. C., WFPI-46, July 29, 1946.

"National Survey of Liquid Asset Holdings, Spending, and Saving Conducted for the Board of Governors of the Federal Reserve System; Part III, Prospective Spending and Saving," Bu. of Agr. Econ., U.S.D.A., Washingon, D. C., Aug. 1946.

The Use of Caley Peas in Alabama's Black Belt

(*From page* 26)

While it was first believed that the crop required lime soil, the Substation is now growing excellent crops of Caley peas on moderately acid land without lime. However, on very acid soils, a lime application previous to planting is essential, the rate varying from one to three tons per acre depending upon the degree of soil acidity. It was also found that Caley peas grow well on bottom lands that are not too swampy but are too wet for clovers and small grains.

Use in Grazing System

Experiments at the Black Belt Substation have furnished evidence that Caley peas can be produced, managed, and used advantageously in forage systems. In utilizing the Johnson grass-Caley pea combination, cattle are grazed in the late fall on frosted Johnson grass, under which are the young volunteer pea plants. Later in the winter and early spring, the Caley peas are grazed. With good fall rains, the peas make enough growth to carry one mature animal on two acres of this combination through the winter without supplementary feed. When germination is delayed by dry weather, it is necessary to supplement the grazing with one to three pounds per head per day for at least a part of the wintering period.

In the 1945-46 wintering experiment, only the sucking cows were fed concentrate for the last 58 days of the 91-day period (December 1 to March 1) in addition to the grazing and stacked Johnson grass hay. Results from this wintering study are:

(1) Dry cows were fed no concentrate during the entire period, and lost an average of 79 pounds. Since they entered the winter carrying excess fat, this loss was of little importance.

(2) Calves entering the wintering period and those dropped during the period made an average gain of 128 pounds per head, or a daily gain of 1.41 pounds per calf. On March 1, the average weight per head, including

birth weight, was 207 pounds. All calves in this study were dropped after October 9.

(3) A total of 4.87 tons of cottonseed meal pellets was fed the sucking cows the last 58 days of the period. This concentrate cost $263.95 delivered. The gain of 6,550 pounds in weight by the calves during the 91-day wintering period at four cents a pound would pay the cost of the bought concentrate.

Advantages of Crop in the Black Belt

In favor of the Caley peas, the Substation has found these advantages if properly managed: (1) It produces considerable quantities of seed, which germinate the following fall; (2) it supplies grazing in late winter and early spring when feed supplies are usually short; (3) it stimulates growth of non-legume crops grown in combination with it; (4) it does not require land-breaking for planting; (5) it will grow on both lime and slightly acid soils; and (6) it will grow well on bottom land that is not too swampy but too wet for clover and small grains.

Toxicity to Livestock

Under certain conditions Caley peas may be poisonous to livestock. The toxic effect of the crop is associated very definitely with the stage of maturity. As the Caley peas reach blooming and seed-forming stage, animals grazing the crop are variously affected.

At the Black Belt Substation, cattle have been grazed on Caley peas during the seeding stage for three successive years. In one of those years the animals became stiff, but all recovered within 30 days and appeared to be normal even though they were left on the peas. In the other two years no toxic effects in the animals were observed. Observations indicate that, as the plant approaches maturity, it becomes less palatable to livestock, and if other vegetation is present they will graze it by preference. The most exaggerated effects of poisoning result when animals are suddenly switched from a dry, short pasture to a Caley pea field in the late blooming or seeding stage.

As far as is known, there is no record of cattle losses directly attributed to Caley peas.

History of Plant in State

The Caley pea (*Lathyrus hirsutus*) is a member of the peavine genus, which includes some 60 species. Actually, it is an old resident of Alabama. The first plant specimen taken in this country was at Mobile in 1880, but it was more than a half century before its forage possibilities became evident.

The recent work is not the Alabama Agricultural Experiment Station's first experience. In 1930, R. J. Goode, farmer and former Alabama commissioner of agriculture, found *Lathyrus hirsutus* growing wild on his farm near Gastonburg, and called it to the attention of the Station. At that time it was included in the experiment with winter legumes. However, it was discarded as a green-manure crop, because it made its growth too late for turning previous to planting most spring crops.

Adaptability of Crop

Because it is better suited for forage in the Black Belt than most other winter legumes, the Caley pea has won a definite place with many of the region's livestock men. Acreage has increased about as fast as seed supplies have permitted. In some localities, demands for Caley pea seed have exceeded available supplies.

Outside of that region, there is some question as to its place and adaptability in forage-cropping systems for other areas. While the Agricultural Experiment Station has established stands of Caley peas successfully on other soil types, further experimental evidence is needed in respect to its productiveness and use as compared with other crops. In experiments at the Main Station, Auburn, for example, earlier and longer grazing have been obtained from manganese bur clover and hard-seeded

crimson clover, neither of which is toxic to livestock.

(*Editor's Note:* The Alabama Station has issued Mimeograph Series No. 17, "Caley Pea Production and Uses in Alabama," by K. G. Baker, Superintendent of the Black Belt Substation. A free copy may be obtained by writing M. J. Funchess, Director, Agricultural Experiment Station, Auburn, Alabama.)

Soil Testing—A Practical Aid to the Grower and Industry

(*From page* 11)

tests produced only 4.26 tons per acre. Those growers mindful of their soil produced more than three tons of tomatoes per acre more than the growers less concerned.

It is believed that soil testing and recommendations made upon sound principles are true aids to both the grower and industry. For that reason to assist the grower in his nutritional problem and to help relieve the world food crisis, more soil testing should be done throughout the country.

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Plant Breeding in Relation to Soil Fertility and Climate

(*From page* 14)

Slightly less striking results were obtained in separate operations for low oil, and for high and low protein. Our result with high number of nodes on the stalk is equivalent to about a 50 per cent improvement of yield. Amazingly, there was no apparent loss of genetic variability during any of these selection operations. Selection could have been continued further with no lessening of effect.

I must emphasize, too, that if we

should go into a field of corn of the original stock of any of these selection operations to look for a single plant equal to the final product, we might not find such a plant in thousands or even many millions of acres. It is hardly too much to say that something really new was produced. But if we should look in a field of one of the well-adapted, old-type varieties for a single plant equal in yield to the best hybrid so far developed, we would probably find it among the first 1,000 plants; certainly in the first acre. This is true in spite of the much greater effort expended on yield of corn. Of course, yield is more dependent on environmental variations and more difficult to measure, but I think we are still forced to conclude that its response to breeding effort is unique and slow. I think that we must learn how to make recurrent selection work with yield of corn if we are to go far in developing efficient nutritional complexes for the higher levels of fertility which good soil management must provide.

In the latter part of the 19th century, there developed among biologists a great interest in continuous or recurrent selection as a possible explanation of the remarkable variations and adaptations of plants and animals. Failure of ear-row selection with corn yield may have dampened enthusiasm for that explanation. Success of hybrid corn possibly gave emphasis to the theory that isolation and inbreeding are necessary for effective selection, as they very probably are. More recently Gossett in Ireland and Fisher in England, the two statisticians who developed the "Analysis of Variance," have re-examined the Illinois ear-row data with oil and protein. They pointed out the remarkable nature of results obtained that I have already noted. Fisher says with respect to the multiplicative aspect of continuous selection, ". . . is a mechanism for generating improbability of very high order."

Still more recently I have undertaken an analysis of some of the data on yield of inbred lines and hybrids of corn as published by various workers or as accumulated from cooperative tests of State Experiment Stations and the U.S.D.A. Here another seemingly enigmatic feature of corn yield has appeared. If we study the several crosses of a weak inbred line with a number of other lines, we find on the average that where the other line is weak the hybrid is weak. Where the other line is strong the hybrid is strong. Among the crosses of a line of medium vigor the same tendency is clear but not so strong. Among the crosses of one of the strongest lines the tendency is hardly evident at all or in extreme cases may appear slightly reversed. The enigmatic feature of these results is not that the tendency decreases as we improve the common parent of a group of hybrids, but that the tendency disappears when the common parent is still a weak inbred line with yield hardly one-half that of an average hybrid.

Prepotency

In analogy, consider a variable herd of cows. If the herd sire is weak and nondescript the calves are variable with merit dependent largely on that of the dams. The sire is not prepotent. If the herd sire is very good, the calves are much more uniform. Those from the poorer cows are not much poorer than those from the better cows. The sire is prepotent. A completely prepotent bull with offspring from poor cows just as good as offspring from good cows would be a very excellent individual. No one has seen an animal so good.

In corn we have apparently a number of inbred lines completely prepotent for high yield. These prepotent lines, while the best we have, are quite weak and unproductive in comparison with ordinary corn.

On the current theory of the genetics of hybrid vigor in corn the most prepotent inbred line should be the equal

of the best hybrid in vigor and yield. This line would not be easily obtained because of genetic linkage of favorable with unfavorable factors, but steady progress toward it by current breeding methods should be possible. A close approach to the goal of a pure line in which all of the more favorable factors are fixed would probably make hybrid seed corn with its renewal each year unnecessary. On this theory hybridity is not truly fundamental for high vigor and yield.

If now we adopt the alternative theory that hybridity is fundamental to high vigor and yield, all of the enigma of corn-breeding experience with yield seems to disappear. Ear-row selection failed primarily because after each ear-row test the best individual ears were taken from the selected ear-rows. The best individual ears were from the most hybrid plants. In them excellence was due not to higher-than-average concentration of favorable factors but to a greater-than-average concentration of hybridity—matching of each more favorable factor with a less favorable mate. Such selection favors the less favorable almost as much as the more favorable factor.

Similarly, second cycles of inbred lines from the parents of the best hybrids in the first cycle failed because the best hybrids of the first cycle were not those with higher concentrations of favorable factors. They were the most hybrid ones, with no greater proportions of more favorable factors than found in original stock. Hybrid corn has succeeded up to a point with certain rare combinations having more than average hybridity. Such rare combinations when once found are repeatable by recrossing the pure parent lines.

The fact that a strong inbred line is likely to combine equally as well with a weak line as with another strong line may be explained on present theory by the greater expectation of hybridity in the cross of strong x weak. Other hitherto unexplained details which now become clear hardly need be enumerated here.

I must emphasize that available evidence is not sufficient for definite proof that hybridity is fundamental for high yield of corn. It is simply that this theory appears more plausible than any other. It leaves no unexplained residue so far as present evidence goes. On this basis we must for the present consider revision of corn-breeding technic towards the goal of the greatest degree of hybridity and abandon the goal of the greatest concentration of favorable factors. How this may be done has been fully described (2), for those regions where hybrid seed corn is commercially feasible.

Ear-row Selection

Where hybrid seed corn is not feasible it would seem well to try ear-row selection again or some modification as the one proposed by Jenkins (3). In such operations secondary selection based on individual appearance must be avoided as strictly as possible.

The newly proposed breeding plan (2) to develop a superior hybrid allows maximum utilization of the multiplicative principle in recurrent selection. There is now no apparent evidence to indicate that it should fail to isolate combinations many times more rare than any we have seen. If this breeding plan should prove to be so powerful, and we have no alternative to trying it out, it must be carefully directed. If we operate this breeding plan with thickly planted test plots of corn following the turning of a heavy crop of legumes with potash and phosphate to balance the nitrogen, the selection may be largely for drouth resistance. This would be particularly likely on lighter soils. If the removal of heavier and more frequent crops of corn should cause a deficiency of, for example, magnesium which was sufficient in the older less intensive system, this deficiency might be hard to detect. For if the breeding system is powerful it will isolate the combinations which

are more efficient and "normal" on the deficient soil. Progress will then deviate somewhat from the best course. I think it may be desirable for the soil chemist and plant physiologist to try to steer the plant breeder on the main course. For this reason I have been willing to try to outline the indefinite but promising state of our knowledge of the genetics of corn yield, and how we may use that knowledge in breeding corn for adaptation to soil and climate.

Of the genetics of yield in peanuts and oats we know even less than for corn. Each one of these crops is naturally closely inbred. There is little prospect of ever using hybrid seed commercially with either one. Oat breeding has so far been largely a matter of isolating disease resistance in pure strains.

Just how the principle of recurrent selection may be most efficiently employed in breeding such crops as peanuts and oats in relation to soil fertility and climate can only be determined by actual investigation of the problem with breeding experiments.

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Tropical Kudzu

(*From page* 25)

cation of complete fertilizer or finely ground superphosphate a month after planting. On acid soils where the pH is below 6.0, an application of finely ground limestone has increased the production of seed and forage. Many kinds of nitrogen-fixing bacteria form nodules on the roots of this legume, especially when grown on an area where the previous legume crop produced root nodules. However, inoculation of the seed before planting appears to be a valuable practice.[3] When an abundance of nodules are present on the roots, applications of commercial nitrogen are not necessary.

Cultivation Is Easy

In Puerto Rico the crop produces seed in the dry season averaging about 150 pounds per acre on soils of average productivity. Seed yields exceeded 300 pounds per acre on clay soils (pH 5.0) treated with limestone screenings, four tons per acre, and chemical fertilizer 6-9-7 at 750 pounds per acre. High production cannot be obtained unless the chemicals necessary for good growth are available to the plants.

Beginning in late December this plant flowers and seeds over a period of 6 to 10 weeks depending upon soil and moisture conditions. As the pods ripen they are harvested by hand and placed on canvas in the sun where they break open upon drying. The seed are about one-sixteenth inch in diameter, and each pound contains a minimum of 35,000. It is advisable to treat the seed for 30 minutes in a 1:1 water-commercial sulphuric acid solution to obtain 90 per cent or better germination in 10 days. The seed seem to germinate better if they are held for six months after harvest at room tempera-

[3] A special inoculant is available for Tropical kudzu through The Nitragin Company, Milwaukee, Wisconsin.

ture and humidity. In Puerto Rico, the unprotected seed have suffered practically no insect damage and have shown satisfactory germination after a three-year storage period under room conditions.

Seed are planted at the beginning of or during the rainy season at a rate of three to five pounds per acre, depending upon the purpose of the crop. If it is desirable to control erosion on steep, more-or-less barren slopes, the seed are sown in contour rows three or four feet apart around the slope. About 10 seed are sown per linear foot in two- to three-inch plow furrows and they are not covered with soil, as sufficient silt will wash into the furrows to cover the seed during the rainy season. The ground should be prepared to a depth of 8 to 10 inches in the neighborhood of the seed. If the ground has little or no slope and the crop is to be used as a ground cover among trees such as rubber, circular patches of ground three feet in diameter and 10 inches deep can be prepared about 15 to 20 feet apart on the square and the seed broadcast on the prepared areas. If rains are irregular, the seed should be scratched in with a rake and covered with about an eighth of an inch of soil.

A quick ground coverage for pastures can be secured by preparing small patches of ground about three feet apart and dropping a pinch of seed on each "hill." Heavier forage and seed production per acre can be obtained if tripods of bamboo poles or living tree posts are arranged at intervals of 10 to 15 feet for the vines to eventually cover. With regular rains, Tropical kudzu under these conditions should thoroughly cover the ground in five to six months and become deeply rooted by the beginning of the dry season.

Tropical kudzu has made luxuriant growth in the higher rainfall belts where the annual precipitation is over 75 inches, but good cover has been produced on areas receiving about 40 inches. More time is required for coverage in areas of lower rainfall. In Puerto Rico it seems to grow faster and make a heavier cover from sea level to about 2,000 feet, than at 3,100 feet. This may be a temperature effect since rainfall is about the same in the test areas.

Tropical kudzu has failed to survive the winters in the Southeastern States. It was killed by frost as far south as Brooksville, Florida, and is truly a tropical plant.

Serves Many Purposes in Puerto Rico

Because it forms a dense mat of runners and dead leaves over the ground, Tropical kudzu climbs over and kills out many undesirable plants. However, the better pasture grasses, such as "malojillo," molasses, and guinea have made good progress growing together with kudzu. Preliminary trials at the Insular Agricultural Experiment Station at Río Piedras indicate that these combinations appear to be desirable for grazing from the standpoint of palatability and nutrient value. On the basis of chemical analyses, Tropical kudzu compares favorably with other legumes and has about three times as much crude protein (15.7 per cent dry basis) as Guatemala and guinea grass. Tropical kudzu produces from 15 to 20 tons of green forage per acre annually under favorable conditions.

During the rainy season cows readily graze the tender foliage of Tropical kudzu, but during the dry season, when growth is slow and the foliage may be somewhat dusty and tough, a day or two is required before the cows become accustomed to it. One acre will graze two cows during the rainy season and about one cow during the dry season.

No Known Commercial Source of Seed

There is no known commercial source of Tropical kudzu seed in the Western Hemisphere at this time. Over 500 pounds of seed were collected this year from the experimental plantings in Puerto Rico. However, inasmuch as

This plot of Tropical kudzu was the best source of green forage for the Station cows during the extended dry season of early 1945. Ten cows pastured the one-third-acre plot for two weeks. Plots of this crop have produced between 12 and 20 tons of forage per acre per year (when cut two or three times) on Catalina clay at Mayaguez, Puerto Rico.

the plant grows rapidly and seeds heavily, it should not take long to extend a planting originating from a small packet of seed. This Station is in a position to supply small packet samples of seed for trials in areas having a tropical climate.

Conclusion

In conclusion it might be stated that Tropical kudzu appears to be the most promising pasture legume available in Puerto Rico. The inclusion of such a legume in cattle forage should reduce the need for imported concentrates, which are the most expensive part of the dairy cattle ration in Puerto Rico. The erosion-resistant qualities of Tropical kudzu on steep hill-sides are also of considerable merit.

Soil Aeration Affects Fertilizer Needs

(*From page* 18)

trogen per cent in plants from both Clarion and Clyde soils. Phosphorus on a percentage basis, increased in the corn with compaction on the Clyde silt loam, but fell slightly in the case of the Clarion loam.

Another way of studying the influence of soil aeration on plant growth was undertaken by forcing air through pots of soil held at high moisture content. The data in the following table indicate that forced aeration increased the growth as well as the per cent of potassium in the corn plants. Distinct potassium deficiency symptoms were eliminated from the plants on both the soils when the aeration treatment was used. In contrast, however, the per cent of nitrogen, phosphorus, calcium, and magnesium was reduced when greater corn growth was made.

It is apparent from this work that when soil aeration conditions are varied the metabolic and physiological processes of growth, root respiration, and salt accumulation are markedly affected. No attempt was made to determine critical limits of oxygen or carbon diox-

TABLE 3

Fertilizer treatment			NP	NPK	NP	NPK
	Soil treatment*	% pore space occupied by air	Yield of tops in grams		% K in plant tops	
Clarion loam	Normal	0.0	13.3	17.3	0.95	2.60
	Aerated	3.2	17.3	27.7	1.28	3.30
Clyde silt loam	Normal	0.0	4.7	13.3	0.65	2.58
	Aerated	0.0	8.1	27.1	1.50	3.80

* Clarion and Clyde soils were held at 40 and 50% soil moisture respectively.

ide supply for corn, but rather the general differences in growth and nutrient absorption were studied at widely varying degrees of soil aeration. Whether these differences were due to an oxygen deficiency, a carbon dioxide toxicity, or a combination of these two factors is not known. The presence of reducing conditions when aeration conditions were considered poor as evidenced by ferrous-ferric iron tests of the soils suggests that some toxic substance may have caused injury to the corn plants.

Summary

A reduction of the total pore space occupied by air by any of the three methods studied resulted in stunted growth and nutrient deficiency of corn plants in most all cases. The absorption of potassium by plants was found to be more dependent on soil aeration than the uptake of nitrogen, phosphorus, calcium, or magnesium. Although the addition of a large amount of potash fertilizer was shown to partly overcome the detrimental effects of poor soil aeration, the maximum benefits of such fertilizer can only be obtained when soil air relations are not limiting factors in plant growth.

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TABLE 4

	Soil moisture	Soil treatment	Relative content	
			Ferrous iron	Ferric iron
Clarion loam	15	Normal	0	+++
	15	Packed	+++	+
	40	No aeration	+++	+
	40	Aeration	+	+++
Clyde silt loam	25	Normal	0	+++
	25	Packed	++	+
	50	No aeration	++	+
	50	Aeration	0	++

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Tip-Burn-Like Condition in Greenhouse Lettuce

(*From page* 23)

of Dr. Steinson, Head of the Agronomy Department of S.I.N.U., and of Dr. Bray, Agronomy Department, University of Illinois, by planting some check plots where borax was applied and similar plots which received no borax. Again the results were phenomenal. The check plots which received borax did not suffer from the tip-burn condition and were about 50 per cent larger in size than the plants that did not receive borax. In the boron-deficient plot this brown tissue-dying condition appeared on practically all of the plants and the yield was twice as small as that of the plot which received borax.

Mr. Ridgway, in 1946, had one of the finest crops of lettuce and tomatoes on this treated soil that he has grown in the last 30 years. He reports that there have been savings or a net increase in earnings of about $10,000 which he feels can be attributed to the improved value of the crops from the borax treatment.

Other greenhouse men in the county have turned to the use of borax on their greenhouse soils and have reported similar results in the increase of yield and the quality of their products.

The Burtons Farm to Feed People

(*From page* 22)

depleted areas and give uniformly good grazing on all of the pasture."

Mowing is regarded as "one of the most important pasture maintenance and improvement practices." Two tractor-drawn mowing machines are used to mow the pastures at the right time to give the most effective control of weeds.

The productivity and quality of the pastures on this farm were evident when as early as May the 250 head of Hereford cattle being grazed were fat enough to go into the show ring.

Pride of the Burton farm is the excellent herd of Hereford cattle. Carefully planned breeding with a relentless search for still better purebred sires, constant culling of all animals that fail to measure up to the high standard set for quality and type, and good feeding to develop fully the potentialities of every individual, have been the formulae followed in improving the herd. Every precaution is taken against the introduction of disease into the herd. Plenty of salt and clean, fresh water are provided. A trained herdsman is employed to look after the breeding, feeding, and management; and Billy looks after the herd with an "eagle eye."

But rating first place as a source of net cash income on the Burton farm

and a top favorite on the Burton restaurant menu are the 4,000 high quality broilers produced every month. Cross-bred baby chicks are purchased and raised in batteries in a modern concrete house that is kept scrupulously clean.

There is a baby chick room, a growing room, and a finishing room, where the right temperature and proper feed are provided until the broilers are ready for the table. The latest type electrically operated machinery is used in picking and dressing the birds, which are immediately placed on ice and sent to the Burton restaurant where they are served to individual customers.

Another important enterprise on the farm is the production of fresh vegetables, such as pole beans, butter beans, roasting ears, tomatoes, peas, and squash, which also are harvested fresh and marketed directly to the consumer through the restaurant.

Likewise, all of the sausage and some of the meat served at the Burton restaurant come from the farm. Both hogs, grade cattle, and cull purebred beef cattle are marketed in this manner, giving the largest possible return for each pound of pork and beef produced on the farm.

While some might question the economy of the large investment and the extensive improvements made on this farm, Mr. Burton last year had to pay income tax on it, despite the fact that he is saving all of his best young cattle and is increasing the size and value of his herd. He can prove that his investment in soil-building, in liming, in liberal use of fertilizers, and in improved machinery and good cattle is paying off.

Mr. Burton has taken full advantage of the AAA farm program. He has carried out twelve different practices including terracing, ditching, growing and plowing under winter legumes, clearing and establishing pasture, applying limestone and phosphate, harvesting legume seed, and building stock ponds.

Let Us Boost the Bee

(*From page* 5)

honey producers. Your entomologist might serve readily, however, as a sound testifier, as he regards the topic objectively. Summaries of such statements I have seen to date usually support the positive belief in the efficacy of the bee and his vital part in the picture of productiveness.

AWAY back in 1859 Charles Darwin through exhaustive experiments showed that continued self-pollination is apt to result in somewhat inferior plants. It has been proved also that hardly any of the pollen of the plum and many other stone-fruits is windborne to other trees, as it is so moist and sticky. Pears are like that too, while the apple being drier in its flower parts is probably wind-blown to some degree. Over in England it was observed that 80 per cent of all the cross-fertilization in orchards is done by the hive bee, not quite 20 per cent by the wild bee, including the bumbling bumblebee, and the remaining bit by the other wild insects.

Our own entomologists remark here that England in many respects is different from our country. Over there, large areas grow thick hedges, and wild spots abound along the roads lined by small farms. In this country, the agricultural zones usually have much larger cleared spaces and open cultivated fields, and thickets and woodlands are dwin-

dling. There is probably greater reliance on poison sprays—so that the proportion of our fruit requiring the service of the honeybee must be higher than in England.

Repeatedly in New York State it has been said that more hives should be kept near orchards. While no study I can cite has clearly laid down the principles by which one must be guided as to bee population and range compared with the size of orchards, it is evident that in some seasons and on some days there are much shorter periods in which the bees will be apt to fly abroad. When the sources of pollen are abundant near at hand the chances are better regardless of sunshine or temperature. To this extent at least it can be pointed out that domestic bees are the only pollen-carrying insects that lend themselves to actual management and direction by the orchardist. Commercial planters probably realize this much more than amateur farm growers.

Of late some interesting work has been going on to see how much actual direction and training a smart honeyman can give to his colonies. It consists of seeing to what extent it is possible to coax bees to gather nectar from certain desired honey plants, both for the type of honey wanted as well as for the partnership in crop culture.

IF fresh ripe clover blossoms, for instance, are collected and placed in dishes mixed with syrup it seems to flavor the concoction enough to induce many of the bees to scout abroad in search of that same nectar—and if within flying range, they will find it. To carry this plan to perfection some folks are extracting the pure nectar from specific plant bloom, and then using this perfume to whet the appetite of their colonies for more of the same brand. Whether this is accomplished through automatic instinct or whether the bees actually whisper or communicate tips on the places to go in search of their favorite "booze" is still within the realm of research. However, I believe this is not going to be sufficient in itself until we get more bees in relation to food plants, or more actual study to link the favorite species from the bee's standpoint with the location of our apiaries. This whole topic is so new and strange, despite the presence of the bee in sacred and profane literature since ancient times, that it should challenge the attention of men as much as all this atomic destruction technique has intrigued science. How long are we going to neglect to cultivate and perfect the arts of peace and spend billions without a quiver for the conduct of war?

MICHIGAN observers tell us that bumblebees were once the main pollinizers of the clover blossom. But their numbers are down these days, as anybody with childhood memories can testify. Even in the country, you do not see those awkward, fat, and fumbling fellows any more to the extent we saw them 40 years ago. There also are some ground-nesting solitary bees which were effective pollinizers in times past, but their homes have been torn up by cultivation, and they do not multiply nearly so fast as domestic bees either. Moreover, it is quite evident that land-clearing campaigns have eliminated many of the natural species of plants with blossoms that attracted wild bees and other insects, and this has choked them off and finally caused wild pollinizers to disappear altogether in farming areas.

It is folly to expect the agricultural regions to return to old primitive wilderness conditions, of course, but intelligent local shrub management might sometimes save clusters of such favorite food sources here and there to enlist some aid from the "tramps" among the insect world. I understand, too, from going afield with a bug specialist, that there are numbers of parasites of the cornborer in the same species that do some pollinizing. Maybe the two services could be jointly promoted. But in this I shall not extend my neck too far

outwardly without benefit of qualified wiseacres.

Unpopular as they are, it must be admitted that ants and some blow-flies are listed among the insects that pollinize fruits in rainy times when honeybees do not go abroad. But they cannot compete with the bee in the long run. There is at least one popular fruit meanwhile that thrives in marshes surrounded by overgrown lands highly favorable for wild insect pollinating, and this is the cranberry. The blueberry likewise does well in such locations. I have never heard any honeyman advertise cranberry honey, however.

IT is a paradox that with the clearing, settling, and open cultivation of land it attains a greatly increased cash sales value over more remote and wilder zones; yet the chances for abundant fruiting and reproduction of food vegetation and the production of field seeds are considerably reduced in those highly cultivated places.

In Nova Scotia's famous Annapolis Valley, studies made about 10 years ago proved that just a few solitary colonies of bees placed in a spot surrounded by large areas devoid of bees has limited value. In places where beekeeping is understood and successfully practiced, one colony to the acre or possibly one to three or four acres may be enough to do the trick. But the chief obstacle to achieving such a balance always turns out to be the lack of expert honeymen and bee-tenders. It's too exacting and "piddling" work for some men, and their chief idea in fruit growing is to find an adaptable variety and then shoot the orchard with poisonous dust or liquid spray.

I guess there is not much which can be done about it, but the shepherd and the bee-herdsman are not any too chummy. Domestic and wild bees both starve and languish on lands heavily populated with grazing flocks of sheep. Close-cropping by the scissor lips of the herbaceous ovine render the vegetation unfit for visitation and sustenance for the bees. The worst offense in this connection is to pasture sheep in woods, because the open meadows may already be robbed of suitable floral baits for bees while some tempting specimens are often left in the timberlands.

Another beautiful way to banish the bees, both wild and home-loving ones, is to start out on a burning campaign. Forest, brush, and grass fires, stubble-burning forays, fence-row firing, and reducing the edges of roads and railways to ashes may have some incidental value against pests, but it cannot be said to aid vegetation or furnish more ranges for the bee population. This may be taken as a hint to let bad weeds flourish and scatter, for which no sane farm-minded guy can argue—but it puts up a poser in perplexities anyhow. It shows that what is meat for some is poison to others, and that what is regarded as good practice may at times be injurious in other ways.

One point, however, where we all agree and can find no ground for abusing each other is in preventing wild forest fires. Campers, careless smokers, and like offenders, as well as heavy timber cutting that exposes forest areas to fire hazards, all combine to put the skids under our hopes for encouragement of wild insect life, especially that of the pollinizers.

DOMESTIC honeybees commonly have an advantage over their wild relatives in their greater brood-rearing capacity. One single queen bee may have 12 to 15 brood cycles in a year, it is said, making in all perhaps 100,000 individuals. In the wild species five brood cycles with a few hundred survivals are closer to average. Winter resistance is much stronger in domestic bees, it is obvious, and it is likely that if winter food is provided some early new brood cycles may appear in the spring before the plants reach full bloom. The custom of the bee to confine most of its activity on a given excursion afield to certain single kinds of plant blooms

enhances its value in agriculture and horticulture.

How many pollen grains does a bee transport at a time? Well, in digging into it I find an authority in New York who claims that it takes about 400 single pollen grains of an apple flower to cover a bee from nose to toes. If it makes hundreds of trips in a season the amount of reproductive aid which one busy bee provides runs into astronomical digits.

Combine this with the knowledge that red clover is self-sterile. The pollen of a flower will not fertilize any flower borne on the same plant. The bee may find other flowers than that of clover which tempt him more, which argues for (1) timing the second or seed-harvest growth to bring it in full bloom when competing adjacent flowers are scarce, or (2) introduction of more bees in the region as a precaution. There are many sides to this relationship, some of them very complex and worthy of further intensive cooperative study.

WE have always held to the belief in our rural philosophy that the farmer is the natural partner with nature and the wild. I begin to suspect that this was probably truer in pioneer times and in wilderness regions which still exist than it is with our deft and accomplished mechanical, commercial farmers of today.

It is always so easy to draw sweeping conclusions and to cling fast to traditional opinions. On close examination we often bob up against such things as these existing in modern times, whereby the original balance of nature has been broken, and yet means exist to restore some of it if we direct ourselves properly. Like thousands of other laymen I could never write a treatise on what I know about the bee, but the fact stares me in the mug that I know so little about the question that it bothers me. Maybe we all require more of the same lessons—for the good of husbandry and the supply of honey.

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PROPOSAL

"Jim proposed to me last night and I'm sore at him."

"What makes you so mad?"

"You ought to have heard what he proposed."

"Rastus, do the people who live down the road from you keep chickens?"

"Dey keeps some of 'em, sah."

Curious Friend: "Why in the world did that saleslady slap you?"

Purchasing Agent: "Darned if I know. All I did was ask her how much she would take off for cash."

A doctor asked his woman patient her age. "I never tell anyone my age," she answered coyly. "But, as a matter of fact, I've just reached twenty-one."

"Indeed," said the doctor. "What detained you?"

PROOF POSITIVE

A seasick sailor was leaning over the rail. The captain, standing nearby, said sternly, "You can't be sick here."

The sailor regarded the captain a minute, then said, sadly, "Watch."

A convincing talker is one who can persuade Willy that algebra is good for his mind.

IT DEPENDS

"How big is your car, Joe?"

"Well, it'll hold four, usually. But you can get six in if they're well-acquainted."

She: "Kiss me once more like that, and I'm yours for life!"

He: "Gosh, thanks for the warning."

The bachelor's a cagey guy,
And has a lot of fun;
He sizes all the cuties up
And never Mrs. one.

Little Woman: "Dear, why can't we live peacefully like the dog and cat lying there by the hearth? They never fight."

"No, they don't but tie them together, and then see what they do."

Father—"I see by the gasoline tank that you did not get very far last night."

Son—"Well, Dad, I'm not complaining."

"I always judge a girl by her figure."

"And I always judge a girl by her brains."

"My system is better. It's a lot easier to tell if she's got a figure."

"Brother Jones," said the deacon, "can't you-all donate some small contribution to de fund for fencing in the cullud cemetery?"

"I dunno as I can," replied Brother Jones. "I don't see no use in a fence around a cemetery. You see, dem what's in there can't get out, and dem what's out sho' doan wanta get in."

Need for—

BORON IN AGRICULTURE

Authorities have recognized that the depletion of Boron in soil has been reflected in limited production and poor quality of numerous field and fruit crops.

Outstanding results have been obtained with the application of Borax in specific quantities or as part of the regular fertilizer mix, improving the quality and increasing the production of alfalfa and other legumes, table beets, sugar beets, apples, etc.

The work of the State Agricultural Stations and recommendations of the County Agents are steadily increasing the recognition of the need for Boron in agriculture. We are prepared to render every practical assistance.

Borax is economical and very little is required. It is conveniently packed in 100 lb. sacks and stocks are available for prompt delivery everywhere in the United States and Canada. Address your inquiries to the nearest office.

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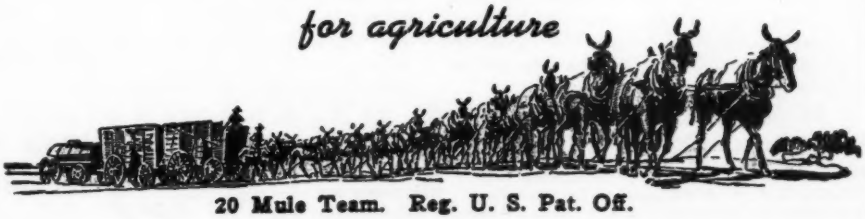
for agriculture



20 Mule Team. Reg. U. S. Pat. Off.

The Meaning of

WHAT are those letters on your building blocks, little boy? What do they mean? Today you are too young to read or pronounce them, much less understand them.

But during the years ahead you will come to know and recognize V-C as the trademark for V-C Fertilizers manufactured by Virginia-Carolina Chemical Corporation to serve thousands of fine folks like you and your family.

Your Dad uses plenty of V-C Fertilizers for every crop he grows, to produce the largest possible profit from his land, labor and machinery . . . profit to buy you a good education and all the comforts and advantages that make life better and happier.

By helping each acre of your farm yield as much as several poorly-fertilized scrub acres would yield, V-C Fertilizers save work, worry and expense. This means more time for your Dad to spend with you . . . and more money for your Mother and Dad to make the farm a more attractive home for you and your brothers and sisters.

The older you grow, little boy, the more V-C will mean to you. V-C scientific research, V-C practical farm experience and V-C manufacturing skill are constantly at work developing better and better V-C Fertilizers . . . so that when you are a man and your Dad turns the farm over to you, it will be a better farm because he used V-C Fertilizers.

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LEADER IN THE FIELD SINCE 1895

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This new, more effective, double-purpose *SPERGON-DDT* costs no more than regular *SPERGON*.

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Combining *DDT* with *SPERGON* in no way changes *SPERGON'S* outstanding qualities as a protectant for hybrid seed corn.

SPERGON continues to be highly effective in seed protection—non-injurious and non-irritating to the user.

Insect Control • Fungus Control

EASY APPLICATION TO SEED

All in one labor-saving operation.

Order your supply of SPERGON-DDT now.

SPERGON-DDT (Wettable) for use in the slurry method of seed treatment.

SPERGON-DDT for the dust treatment of seed.

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THE PLANT SPEAKS

A new four-reel series of 16 mm., sound, color films which may be booked independently or in any combination. They may be used to best advantage when shown at least one day apart and in the following sequence:

THE PLANT SPEAKS THRU DEFICIENCY SYMPTOMS pictures soil depletion, erosion, and deficiency symptoms on plants. (Running time 25 min. on 800-ft. reel.)

THE PLANT SPEAKS, SOIL TESTS TELL US WHY depicts taking soil samples on the farm and the interpretation of soil tests. (Running time 10 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU TISSUE TESTS shows the value of tissue testing and the procedure for testing plant tissues in the field. (Running time 14 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU LEAF ANALYSIS evaluates leaves in plant growth and leaf analysis in determining fertilizer needs. (Running time 18 min. on 800-ft. reel.)

We shall be pleased to loan these films to agricultural colleges, experiment stations, county agents, vocational teachers, responsible farm organizations, and members of the fertilizer trade.

OTHER 16MM. COLOR FILMS AVAILABLE FOR TERRITORIES INDICATED

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In the Clover (Northeast)
Bringing Citrus Quality to Market (West)
Machine Placement of Fertilizer (West)
Ladino Clover Pastures (West)
Potash from Soil to Plant (West)
Potash Deficiency in Grapes and Prunes (West)
New Soils from Old (Midwest)
Potash Production in America (All)
Save That Soil (All)

IMPORTANT

Requests should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of time of loan.

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